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THE KANSAS PUBLIC-SERVICE COMMISSION.

The act recently enacted in Kansas establishing a public-service commission is one of the most comprehensive that has been passed in any of the states. The powers vested in the commission are very broad and cover all kinds of public utilities except those operated by municipalities, and mutual telephone companies which are rather numerous among the farmers. The commission has authority over issuing securities, mergers, declaration of dividends, and transference of franchises, as well as the more usual powers of regulating rates and service.

The present Board of Railroad Commissioners becomes the new public-service commission, the members serving out their original terms of office. Thereafter the Governor will appoint one of the three commissioners each year.

All public-utility corporations must file full accounts each year, and the commission is to make valuations of physical property whenever occasion for the same arises.

It is coming to be generally recognized that the functions of a public-service commission are to protect both the customers and the owners of public utilities, and that while preventing extortionate charges they should see that the interests of the investor are also protected. This can be more easily accomplished where supervision over the issuance of securities is exercised, and this provision of the new law is to be commended. It protects the investing public from the over-enthusiastic or fraudulent schemes of wildcat promoters and gives the securities approved a standing in the financial market. Supervision of dividends is going a step further than the New York law, and it may be questioned whether this power is a desirable one. There need be little fear, however, that this power will be abused, for there would be no good reason for refusing dividends where proper provision has been made for upkeep and depreciation. Indeed, the provision will probably result in better attention being given to the establishment of a proper depreciation reserve than has been customary in the past. In setting up a proper relation between dividends and rates, it would seem necessary to pass upon the vexed question of a proper return to invested capital. While this return need not be the same in all cases, it is difficult to avoid following precedent where the conditions are similar, and we may look forward to some interesting decisions in Kansas in this matter. The whole question of whether profits

are to be limited to a fixed percentage on the capital, or whether they shall depend upon the volume of business transacted, will be involved. This is a matter which has not been sufficiently discussed and does not seem to have received sufficient attention from commissions heretofore.

The distinction to be made between maintenance and depreciation funds is another difficult question, and one which is especially appreciated by those who have endeavored to make the separation in actual expense accounts. The methods used by accountants are often rather crude, as is indicated in an article on "Apportionment of Expenses," which will be found in this issue. The formulation of definite rules for such accounting would seem to become more necessary and even inevitable as the powers of the public-service commissions become enlarged.

THE CONVENTION SEASON.

Once more the electrical industry is busy with its state and national conventions. This is a season of the year when the reading of papers and the discussion of topics incident to the conduct of the electrical business is rampant and one must needs use seven-league boots to keep in touch with the many meetings that are now going on. But recently the Iowa State electrical and railway associations held a joint convention at Davenport, followed immediately by the convention of the Southwestern Electrical and Gas Association at Houston, and by the Nebraska Electrical Association at Lincoln. During this week the convention of the Arkansas Association of Public Utility Operators is being held at Little Rock. The National Electric Light Association holds its annual convention in New York from May 29 to June 3, and the National District Heating Association holds forth in Pittsburg from June 6 to 8. The Association of Railway Telegraph Superintendents holds its meeting at Boston June 19 to 23, and the Mississippi Electric Association its annual convention at Gulfport, June 20 and 21. The American Institute of Chemical Engineers holds its semi-annual meeting in Chicago, June 21 to 24, the Society for the Promotion of Engineering Education its annual meeting in Pittsburg, June 26 to 28, and the American Institute of Electrical Engineers holds its annual convention in Chicago, June 26 to 30.

The Michigan Electric Association will establish a departure this year when it will hold its convention aboard the steamship *Minnesota*, making a most interesting lake trip between several famous stopping places, from June 19 to June 22, while the ever welcome and thoroughly enjoyed convention of the Ohio Electric Light Association will be held as usual at Cedar Point, July 25 to 28. To those who have been in the habit of attending the conventions of the latter association it will be noted with pleasure that there will only be one afternoon session, the second, third and fourth sessions being held each morning. Also, the association will give three banquets this year instead of two.

THE CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Announcement was made last week that on April 18 there was a total of 7,521 names on the membership list of the National Electric Light Association. This includes the addition of something like 1,163 names during the month preceding that date. A year ago, with a much smaller membership, there was a remarkable attendance at the St. Louis convention. It is therefore reasonable to assume that the thirty-fourth convention, which will be held in New York City from May 29 to June 2, inclusive, will bring an attendance at the convention of at least 3,500 people. This means that special efforts must be made looking to the entertainment and comfort of a large number of people. That the acme of satisfaction will be attained is assured, so excellent is the organization of the committees having to do with the various arrangements.

Year by year attendance at the convention of the National Electric Light Association is becoming a more serious business proposition. So comprehensive is the scope of the work undertaken by the various committees and so illuminating the reports of the various departments that it takes a major portion of the time of the convention for solid discussion.

Among the important subjects which will come up for discussion none will receive greater attention than the study of the various aspects of welfare work as related to the central-station industry. We can all remember the profound satisfaction with which happy epigrams of Paul Lüpke struck us several years ago, and the pride we had in the immediate encouragement which was given to the welfare idea by the big men prominently identified with the industry.

Under the direction of the Public Policy Committee this work has been carried forward. At the convention this committee's report will give in detail the methods by which provision can be made for the adoption of certain of the schemes proposed, taking into consideration the wide differences which may exist in different communities and companies not only regarding financial resources, but in the personality of the employees and in public sentiment. It is gratifying to realize that the committee has felt it important that all notions of philanthropy or charity be entirely eliminated and that the plans suggested cover a relationship only of the most practical mutuality in the conduct of the organization toward its employees with reference to the service rendered.

The conservation of water powers and establishment of reasonable conditions under which these may be developed to the full benefit of the many will receive attention and it is expected that the impetus given to the matter of the sale of electrical energy through every medium of consumption through the formation of the new Commercial Section will greatly enlarge our possibilities in this direction.

While the meeting will be notably of a work-a-day character, there will be intermissions and interludes which will afford edification and recreation. On Monday evening, May 29, there will be a promenade concert followed by an enter-

tainment and dancing. Other forms of entertainment will include theater parties, baseball games, separate entertainment for the ladies, including automobile rides to points of interest in the vicinity, a golf tournament, a rejuvenation by the Sons of Jove at Coney Island, and inspection trips to plants.

The transportation committee is hard at work and has announced its schedule of special trains, while the hotel committee is actively engaged arranging for specific reservations. It must be realized that through co-operation upon the part of those intending attendance the work of these committees can be simplified, and it behooves all interested to complete their own arrangements at as early a date as possible.

EXPLOSIONS AND ISOLATED PLANTS.

In a report which was issued by a boiler inspection and insurance company a short time ago the fact is brought out that in the year 1910 there were, in the United States, 550 boiler explosions resulting in the death of 277 persons, and the injury of 506. This number is not materially different from the ones given for each of the four preceding years.

It is rather a significant fact that in this list of accidents only a few central stations appear. On the other hand the number of isolated plants in which accidents occurred is comparatively large. At the present time only a few states require boiler inspection and insist upon certain requirements which must be met by companies wishing to operate steam boilers for various purposes. The length of time which a faulty boiler may continue in operation depends only upon the willingness of the operator to take the risk, and the judgment of those in authority.

The fact of the large percentage of explosions in isolated plants and the small percentage in central stations is readily explained by the more expert supervision to which the power and lighting equipment is subject. Small manufacturing plants which might benefit by the use of electric drive sometimes secure their power from a steam plant in charge, not of an expert, but of the person who is most readily available for the work. While everything is to all appearances operating smoothly, such an engineer takes little thought of anything internally deficient, even if he could spare the time from his other duties for proper and regular inspection.

Contrast this state of affairs with the conditions in a modern steam plant generating electric power for outside consumers. Inspection, efficiency tests, constant and careful supervision with an eye to the uninterrupted generation of power at the lowest cost and the selection of expert employees have reduced the number of explosions in those plants to a minimum. The field for electric power has grown marvelously and with every instance of carelessness in the operation of small steam plants, one more advantage of central-station service, that of safety, is being forcibly brought to the attention of the power-using public.

OIL-SWITCH DESIGN.

The multiplication of electrical devices for power and sub-station service and their rapid standardization through modern facilities of manufacture have a tendency to lead the operating man to take a great deal for granted in purchasing and utilizing such equipment, especially in connection with auxiliary apparatus. It is important, however, not to overlook the details of design and construction, since the selection and maintenance of the equipment are important factors in the economical and reliable service of modern plants. The ordinary oil switch furnishes a good example of a device whose *physics* should be considered in applying it to power-plant service, quite as much as the manufacturers' quotations. The arrangement of the contacts with respect to submersion clearances allowed by the designers between the walls and moving parts, provision for inspection, cleaning and replacement of the oil supply and the wearing contacts, protection against fire, tendencies of the arc to be lengthened and extinguished under increasing liquid pressure and the disposition of carbonized particles of oil and soot inside the insulating chamber should all be examined. The condensation and mechanical displacement of arc vapors are matters of the utmost importance in dealing with considerable quantities of energy in the limited space usually available for oil-switch insulation on the direct-control principle. These points all go to show the importance of purchasing auxiliary electrical apparatus upon the strength of sound technical investigation. It takes time to analyze the physical features of competitive equipments, but it is time well spent.

FREE TRANSPORTATION OF GOVERNMENT EMPLOYEES.

A recent opinion of Attorney-General Swift of Massachusetts regarding the free transportation of United States letter carriers in uniform on electric railways effectually calls a halt on attempted legislation of wide interest to public-utility corporations. A vigorous effort has been made in Massachusetts this year to pass a bill requiring street railways to provide free transportation for letter carriers, and the Attorney-General, upon being asked for an opinion, emphatically declares that such statute would be in violation of the Constitution. He points out that there is an undoubted right of legislatures to regulate fares, but that companies cannot, under the pretense of such regulation, be required to carry persons or property without reward, and that such a statute would not be a proper exercise of the rate-making power. The free carriage of police obviously presents advantages to a street-railway company through the insurance of orderly conditions, but the carriage of any special class of persons, such as letter carriers, without compensation to the public-utility corporation, is in no sense justifiable on the ground of police power.

Annual Convention of American Institute.

The annual convention of the American Institute of Electrical Engineers, for 1911, will be held in Chicago, Ill., on Monday, Tuesday, Wednesday, Thursday and Friday, June 26, 27, 28, 29 and 30, 1911. The Institute headquarters will be at the new Hotel Sherman, northwest corner of Clark and Randolph Streets. There will be a reception on Monday evening, and the technical sessions will open on Tuesday morning. The Convention Committee will have charge of the local arrangements. The members of this committee are as follows: Louis A. Ferguson, Chairman; W. L. Abbott, B. J. Arnold, H. M. Byllesby, W. Lee Campbell, T. P. Gaylord, William B. Jackson, J. W. Johnson, John D. Nies, W. P. Sidley, B. E. Sunny, Fay Woodmansee, P. B. Woodworth, J. G. Wray.

The following sub-committees have been appointed by Chairman Ferguson:

On Papers, Messrs. Wray, Johnson, Gaylord, Jackson and F. A. Sager.

On Finance, Messrs. Sunny, Byllesby, Arnold, Gaylord and Ferguson.

On Publicity, William E. Keily, chairman, J. R. Cravath, F. H. Reed and A. A. Gray.

The following is a partial list of the papers that will probably be presented: "Economical Design of Direct-Current Magnets," by R. Wikander; "Catenary-Span Calculations," by W. L. R. Robertson; "Currents in Inductors of Induction Motors," by H. Weichsel; "Multiplex Telephony and Telegraphy by Means of Electric Waves Guided by Wires," by Major G. O. Squier; "Electrolysis in Reinforced Concrete," by C. E. Magnusson; "Induction-Motor Design," by T. Hoock; "The High-Efficiency Suspension Insulators," by A. O. Austin; "The Electric Strength of Air," by J. B. Whitehead; "Electrification Analyzed, and Its Application to Trunk Line Roads," by W. S. Murray; "Telegraph Transmission," by F. F. Fowle; "The Cost of Transformer Losses," by R. W. Atkinson and C. E. Stone; "The Costs of Railway Electrification," by B. F. Wood; "Induction Motor for Single-Phase Traction," by E. F. W. Alexanderson; "Magnetic Properties of Iron at 200,000 Cycles," by E. F. W. Alexanderson; "Electric Storage Batteries," by Bruce Ford; "The Characteristics of Isolated Plants," by P. R. Moses; "Elevator Control," by T. E. Barnum; "Limits to the Use of Resistance Materials."

Ohio Convention Announced.

The annual convention of the Ohio Electric Light Association will be held on July 25, 26, 27 and 28, at Cedar Point, O. Sessions for the reading of papers will be held in the mornings, the afternoons being left free for diversions. There will be three banquets in connection with the convention.

Convention of Michigan Association.

The eighth annual convention of the Michigan Electrical Association will be held on board the steamer *Minnesota*, a new vessel just being built by the Chicago & Duluth Transportation Company, in Manitowoc, Wis. The vessel has sleeping accommodations for 300 people and has the finest appointments of any on the Great Lakes. The steamer will leave Grand Haven on the evening of Monday, June 19, and after a trip to Sault Ste. Marie and Mackinac Island, will arrive on the return trip on the morning of Thursday, June 22, and will arrive at St. Joe at 4:00 p. m. on the same day. A charge of $25 will be made, including berth and meals.

Edison Medal Presentation Ceremonies.

The ceremonies attending the presentation of the Edison Medal to Frank Julian Sprague will be held in the Engineer's Building, New York City, on Tuesday evening, May 16, 1911, at the annual meeting of the American Institute of Electrical Engineers. The program as arranged will include the presentation of the medal and certificate of award to Mr. Sprague to Dugald C. Jackson, president of the Institute, and a number of addresses will be made indicating the result of Mr. Sprague's work along the lines of electric railway development and the use of electricty in the navy. Among the speakers and subjects will be: "The Development of the Electric Railway," by W. B. Potter; "Social Results of the Introduction of the Electric Railway," by F. H. Giddings; "The Relation of Governmental Control to the Development of Electric Railways and the Electrification of Steam Lines," by George F. Swain. There will also be an address on the subject, "The Results of the Use of Electricity in the Navy," the speaker to be announced later.

The American Society of Mechanical Engineers.

At the meeting of the American Society of Mechanical Engineers in New York, on May 9, several important papers on the subject of patents will be presented and discussed by E. W. Marshall, D. H. Haywood and E. J. Prindlow.

At the spring meeting of the Society, to be held in Pittsburg, Pa., May 30 to June 2, cement manufacture will be one of the principal subjects considered. Among the other papers to be presented are "Commercial Application of the Turbine Turbo-Compressor," by R. H. Rice, "Purchase of Coal on the Heat-Unit Basis," by Dwight T. Randell, "Energy and Pressure Drop in Compound Steam Engines," by F. E. Cardello. There are also to be sessions on Gas Power, Machine-Shop Practice and Steel-Works Practice.

Electrification in Chicago.

The Committee on Electrification of Terminals, which has been appointed in Chicago by the Association of Commerce in co-operation with the railroads and the city government, has elected as its chief engineer, Horace G. Burt.

Mr. Burt is well known in railroad circles, having served as president of the Union Pacific Railroad and in other capacities with a number of other roads. He is at present a consulting engineer in Pittsburg.

The permanent officers chosen by the electrification committee are: chairman, Jesse Holdom; vice-chairman, T. E. Donnelley; secretary, Frederick H. Rawson, president of the Union Trust Company.

A report containing recommendations as to the scope of the investigation to be undertaken by the commission has been presented by a subcommittee consisting of Milton J. Foreman, Harrison B. Riley and W. A. Gardner. According to this committee the investigation should include:

(1) The necessity for any proposed change.

(2) The mechanical practicability of any such change, and

(3) The commercial feasibility thereof.

These heads naturally subdivide into many specific subject matters, which in the opinion of the committee, will and should be developed by the expert in charge.

W. J Wilgus.

The electrification of the terminal of the New York Central & Hudson River Railroad may be said to be one of the most imposing and instructive engineering undertakings of recent years. The experiences gained in this work and the data formulated have been used to good advantage by engineers on similar enterprises, and that the work was initiated successfully and carried to a brilliant conclusion is due largely to the constructive ability of William John Wilgus. It was under the direction of Mr. Wilgus, co-operating with other notable engineers, that the original plans for the electrification of the New York terminal of the New York Central were laid out. It was under his direction that construction was begun, and it was under his direction that the first electrified units successfully operated over the electrified zone.

W. J. WILGUS,
A Leading Exponent of Trunk-Line Electrification.

William John Wilgus was born in Buffalo, on November 20, 1865, the son of Frank Augustus and Margaret Wilgus. He graduated from the Buffalo Central High School in 1883, following this with two years' tutorage in civil engineering in Buffalo. He began his railway service as a rodman in 1885, and was draftsman, resident engineer and division engineer of construction of the Minnesota & North Western Railroad (now the Canadian Great Western Railway) from 1885 to 1890. He was locating engineer of the Duluth & Winnipeg Railroad, of the Duluth & Iron Range Railroad extension to Mesabe Range, and resident engineer in charge of construction of the Chicago Union Transfer Railroad from 1890 to 1893. He was assistant engineer of the Rome, Watertown & Ogdensburg Division of New York Central & Hudson River Railroad from 1893 to 1897. In 1895 he was chief engineer of the Terminal Railway of Buffalo, and in 1897 and 1898 resident engineer of the Eastern Division, chief assistant engineer, assistant engineer of maintenance of way in 1899, chief engineer of construction and maintenance of way, in charge of reconstruction and enlargement of terminals, bridges, etc., including the Grand Central Station at New York and Weehawken Terminals of the New York Central from 1899 to 1903. He was vice-president in charge of construction, including new extensions, change of motive power from steam to electricity of the Grand Central Station and other electric zone improvements on the New York Central from February, 1903, to September, 1907. He was later made chairman of the New York Central & Hudson River Railroad Electric Traction Commission. He was chairman of the Advisory Board of Engineers for the construction of the tunnel under the Detroit River, connecting the Michigan Central Railway and the Canadian Southern Railway. He was chairman of the Union Station Commission of Buffalo, and more recently was interested with several prominent engineers and financial men in the development of a subway freight system serving the entire city of New York.

Mr. Wilgus has been a consistent contributor to the technical press, and is the author of many valuable technical papers and reports. He is a member of the American Society of Civil Engineers, the American Railway Engineering and Maintenance of Way Association, the American Railway Guild, the St. Paul Society of Civil Engineers, the New England Society, the Chamber of Commerce of New York, the Sons of the American Revolution, and the Century and Railroad Clubs.

He has just been tendered a high honor by the Institution of Civil Engineers of Great Britain, which has awarded to him the Telford Gold Medal.

Next Joint Meeting in Chicago.

The next joint meeting of the Chicago Section of the American Institute of Electrical Engineers and of the Electrical Section of the Western Society of Engineers will be held in the Society's roms in the Monadnock Block, Chicago, on May 24. A paper on the subject, "Notes on a Telephone System Recently Built in San Francisco and Its Neighborhood," will be read by S. G. McMeen, who for several years has been engaged in the installation of telephone systems in Pacific Coast cities.

To Celebrate Railroad Opening.

The Chamber of Commerce of Alameda, Cal., has made preparations for ceremonies to mark the opening of the electric suburban system of the Southern Pacific Railroad Company. The line will probably be put in operation about June 1.

Pushing Electric Vehicles.

The Public Service Corporation of Newark, N. J., contemplates the expenditure of $40,000 for the purchase of electric vehicles and to push their sale throughout the state.

The Virginia Railway & Power Company, of Richmond, Va., contemplates opening a public garage.

PROPOSED SUBWAY FOR CHICAGO.

ADDRESS BEFORE CHICAGO ELECTRIC CLUB.

Plans of the proposed subway for Chicago were discussed by Bion J. Arnold, chief engineer Board of Supervising Engineers, Chicago Traction, at the meeting of the Chicago Electric Club on April 26, the discussion being illustrated by drawings of each successive step in the building of the system.

Mr. Arnold first said that the general plan provides for a comprehensive system which will be capable of unlimited expansion. However, on account of financial considerations the plans have been so worked out that the subway may be built in steps, each conforming to the general scheme, which when completed would make a grid-iron of Chicago's streets.

The first drawing described was designated as the "first step" of the proposed Chicago subway system. The first subway would start on South Clark Street at Archer Avenue and utilize the La Salle and Washington tunnels to cross to the north side of the river into whatever territory might be decided upon by the needs of traffic.

This one subway would, declared the speaker, relieve congestion at the loop on the elevated lines and on Clark Street. It would cost $8,000,000 and the city has $6,000,000 now to use for the enterprise and could raise the other two.

The next step in the subway system as shown by Mr. Arnold started the tunnel on State Street at Twelfth and continued to Chicago Avenue, thence west wherever desired. The second subway would enable surface cars on State Street to run with greater speed and, therefore, handle traffic on the most important street in the city in a much more satisfactory manner than at present.

Various other steps were described, Mr. Arnold explaining that the plan provides for no grade crossings underground. The lines running east and west will be placed at a lower level than the north and south lines.

Mr. Arnold referred to the methods of providing finances for the big undertaking as follows:

Granting an indeterminate franchise to a private corporation with right to purchase. Construction by the city, but operation and maintenance by private contract, city reserving right to purchase equipment. Construction and equipment by city and operation by private contract. Assessment of property for construction in much the same method that a sewer or paving district is created.

Preceding the address of Mr. Arnold, President Niesz announced that A. A. Gray had been elected vice-president of the club to fill the vacancy caused by the resignation of C. A. Howe.

On Thursday evening, April 27, the annual smoker and entertainment of the club was held at the Illinois Athletic Club. A pleasing musical and entertainment program was provided which was followed by Dutch lunch.

New York Subway Offer.

The Brooklyn Rapid Transit Company recently made a formal presentation of its subway offer to the city of New York in a letter to George McAneny, chairman of the Transit Committee of the Board of Estimate, and William R. Wilcox, Chairman of the Public Service Commission.

The present offer includes the operation of the Broadway-Lexington Avenue Subway in Manhattan and its extensions in the Bronx, with the subway and elevated extensions in Brooklyn, Manhattan and Queens, covered in the earlier proposition, and establishes a five-cent fare in all boroughs, including a possible extension under the Narrows to Richmond, except to Coney Island.

The company proposes to spend $75,000,000 of its own capital in extending its elevated lines, connecting its old steam surface lines in South Brooklyn and Flatbush with the proposed new subways, and equipping the new subways and elevated for operation. It estimates the maximum financial requirement for the city at $83,500,000, based on the large-size tube originally planned for the Triborough Subway. On a reduced bore the proposed use of the city's credit is cut down to $73,500,000.

A New Source of Copper.

Deposits of copper ore have been discovered on the Vestmanna Islands, south of Iceland. The deposits are understood to be of considerable magnitude.

Large Electrical Properties in Northeastern Illinois Being Merged.

The Chicago press has just announced that negotiations are under way for merging three of the largest central-station companies in northeastern Illinois outside of the city of Chicago. The companies concerned are the North Shore Electric Company, which supplies electricity to nearly seventy cities, towns and villages north, west and south of Chicago, and has its principal stations at Waukegan, Evanston, Maywood and Blue Island, Ill.; the Economy Light & Power Company, which supplies electricity to nearly a score of communities southwest of Chicago, and has its principal station at Joliet, Ill.; and the Illinois Valley Gas & Electric Company, which has combined the gas and electric plants in about twenty-eight communities in and near the northern part of the Illinois River valley.

The three companies have a combined capital stock of $11,564,000 and a funded debt of $9,751,000, which brings their total capital to over $21,000,000. The annual gross business exceeds $2,500,000 and the net revenue is about $1,000,000. A population of over 700,000 in the large crescent-shaped area about Chicago is served by the three companies. Full details of the merger have not yet been announced officially.

National Fire Protection Association.

The fifteenth annual meeting of the National Fire Protection Association will be held May 23, 24 and 25, in the Astor Gallery of the Hotel Waldorf-Astoria, New York City.

The Insurance Society of New York has invited members attending the meeting to be its guests at its tenth annual banquet at Hotel Astor, Tuesday evening, May 23.

The Magnetic Club.

The Magnetic Club, composed of telegraph men, held what is called its "Family Dinner" at the St. Denis Hotel, New York, April 26. Charles P. Bruch, vice-president of the Postal Telegraph-Cable Company, and president of the club, presided.

Among the speakers were John B. Taltavall; Daniel Moore, editor, New Orleans *Times-Democrat*; Marion J. Pike; E. J. Nally, vice-president and general manager of the Postal Telegraph-Cable Company, and others. The very pleasant evening concluded with songs and story telling.

The Midland Railway Power House.

A New Installation at Derby, England.

BY OUR BRITISH CORRESPONDENT.

A new power station has recently been completed by the Midland Railway Company at Derby, for the purpose of supplying electricity for the locomotive, carriage and wagon, signal, telegraph, general stores, and other departments, also for lighting these and the entire chief offices of the railway company. With the courteous assistance of H. Fowler, the company's chief mechanical engineer, and of J. Dalziel, who designed and supervised the installation under Mr. Fowler, the writer is enabled to give the following illustrated account of the work. It may be stated at the beginning that a good deal of the plant has been manufactured in the Midland Railway Locomotive Shops.

The plant installed is of 3,000-kilowatts capacity, and the normal load, on the present basis, is about 1,900 kilowatts.

As part of the undertaking a new bridge has been provided spanning the canal, both as a means of approach, and for the conveyance of coal, to the power station, which is situated between the canal and river near the locomotive works. Coal is delivered on the locomotive-works side of the canal and elevated and conveyed to the power station over the bridge, as will be observed in the photographs. The elevator hopper, which has a capacity of twenty tons, was made in the locomotive shops, as was also the bridge itself. This bridge has two main girders of box section supported from walls at either end and from two sets of intermediate stanchions. One end is free, and the connection with the stanchions is a sliding one to allow for expansion. The bucket elevator and conveyor belt have a capacity of fifteen tons per hour; the belt is of water-proofed surface canvas, 185 feet long by 18 inches wide. A ten-ton Royce crab, which runs on the bottom flange of the bridge girders and was used during the construction of the power house for conveying machinery, etc., will in ordinary running serve for the removal of ashes, etc. The power cables and water supply for make-up feed for boilers, etc., are carried over this bridge.

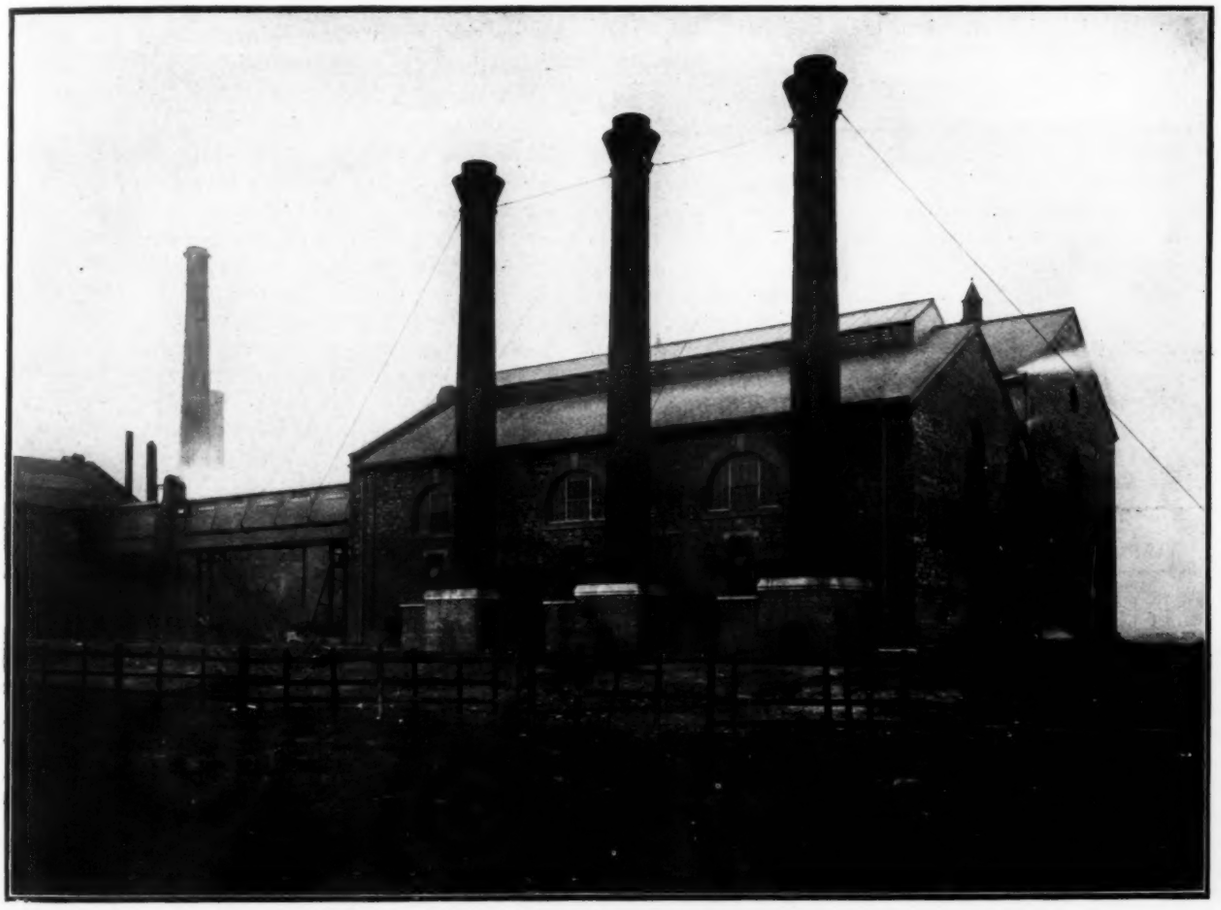


FIG. 1.—THE MIDLAND RAILWAY POWER HOUSE AT DERBY.

The equipment of the power station includes two 1,250-kilowatt Willans and Robinson turbogenerators of the disk and drum type, running at 3,000 revolutions per minute. There are two rows

of impulse blading, and five stages of three rows each of reaction Parsons blading. Steam is supplied through fourteen nozzles, four of which are permanently open, three operated automatically for overload, and the remainder are hand-operated in two sections of four and three. An emergency governor comes into action if the main governor fails. A pump driven from the turbine shaft supplies forced-oil lubrication at ten pounds pressure; the oil is filtered and passed through a cooler before being returned to the bearings. The electric generators (Siemens) are of the revolving-field type, two-pole, fifty cycles, 460 volts, three-phase. The exciters are direct coupled. Air for cooling is drawn from the condenser room and is delivered into the engine room. The main condensers which are of the Willans surface type, have each a cooling area of 2,160 square feet, and have vacuum augmentors. In case of failure of vacuum, the turbines can be put to atmosphere by Alley and MacLellan's auto-valves. The air pumps are of the Edwards type, three-throw, eleven inches diameter, seven-inch stroke.

For service during light nights and week-end loads, also in the event of a turbo-alternator becoming disabled from any cause, two small engine-driven sets (Willans central-valve-type engines) removed from other electrical stations of the Midland Railway Company, with new Scott and Mountain generators of 250 kilowatts and 160 kilowatts capacity respectively) are installed. These two sets originally ran non-condensing, but a single Storey condenser is now fitted to both.

The main low-tension switchboard (Cowans) has four generator, three transformer, four feeder, and one each testing, station lighting, lighting distribution, and spare, panels. Three British Westinghouse 400-kilowatt transformers raise the pressure from 460 volts on the main bars to 6,600 volts for transmission to the Carriage and Wagon Department through two paper lead-covered cables.

The high-tension switchboard, which is fitted with Ferranti switchgear, was made by the Railway Company; it controls the 6,600 volts supply to the department just mentioned. There are three transformer, and two feeder cells. The normal load is about 600 kilowatts. Two British Westinghouse 150-kilowatt rotary converters provide a 440-volts continuous-current supply for cranes, etc., in the locomotive shops, and for driving the auxiliaries in the power station; each of these sets has its own auto-transformer and switch panel.

The engine room has a fifteen-ton overhead three-motor electric crane.

The condensed water from the turbines can be returned either direct to the hot-well or through a Lea recorder notch tank. The piping is so arranged that any one, or all, of the discharges can be measured. The recording instrument is fixed on the turbine-room floor. Circulating water is obtained from the river mentioned earlier in this article, and is pumped up by two Rees-Roturbo pumps, each with a capacity of 2,200 gallons per minute. These are situated in a well by the river and are driven by vertical-shaft motors, which are controlled from the engine room. The water is taken through pipes two feet in internal diameter to the condensers, and returned to the river, the outlet being drowned at the level of the river, so maintaining a siphon action. A steam ejector is provided in the turbine room to deal with the air released from this water, and a small electrically driven air pump is shortly to be installed for this purpose. A Hall steam feed pump delivers 40,000 pounds of water per hour, and an electrically driven turbine pump (Rees-Roturbo) with capacity of 40,000 pounds per hour, driven by a fifteen-horsepower variable-speed motor, runs at 2,250 revolutions per minute.

The boiler plant consists of five Stirling boilers. Three of these are drum-type, with three steam and two mud drums. They have 480 tubes 3.25 inches in diameter. The temperature of the flue gases is about 500 degrees Fahrenheit. Foster superheaters, and underfeed automatic stokers, arranged to burn low-grade cheap coal, commonly known as smudge, are fitted. Forced draught is supplied through ducts passing under the boilers from back to front; the fans give normally 12,000 cubic feet of air per minute each, at 2.25-inch water gauge, and when forced 15,000 cubic feet at 2.75-inch water gauge. The motors which drive these fans were made in the Railway Company's own electrical works. Each boiler has a separate chimney of 4.5 feet internal diameter, rising to sixty feet above grate level, and lined to a height of thirty feet. A Simmance and Abady CO_2 recorder continuously samples the flue gases.

FIG. 2.—BRIDGE OVER CANAL.

FIG. 3.—CONVEYOR BELT.

An ash subway is provided under the boiler room at the front of the boilers to allow of easy removal of the ashes, and the feed tank and make-up water supply is also arranged here.

For distributing power to the various shops the main cables are run overhead on the walls, and in and on the roofs of the locomotive shops; they are all three-core bitumen-insulated, and are carried in boxing except in the case of the high-tension cables to the carriage and wagon shops, and these are paper lead-covered.

Electric Pumps in Spanish Horticulture.

The small cultivators in the immediate neighborhood of Seville, Spain, are rapidly substituting electric power for the old noria, or endless chain of buckets worked by a mule or bullock, with which they have hitherto raised the water from their wells for purposes of irrigation. A European paper states that the Electric Company of Seville has made arrangements for supplying current over the horticultural zone which extends for some two or three miles round Seville, and within the first year fifty-six installations were made, with a total of 362 horsepower. The current is paid for by the hour, according to the size of the motor. A five-horsepower motor costs sixty-four centimes (twelve and one-third cents) per hour and raises sixty-five cubic meters (2,295 (2,295 cubic feet) in that time.

The Commercial Section of the National Electric Light Association.

In connection with the development of the National Electric Light Association, the Commercial Section, one of the most recent evidences of the expanding scope of the electrical industry, is attracting very widespread attention.

A great many questions are being raised by those who are seeking affiliation within this section. A very interesting communication appears in the April *Bulletin* of the National Electric Light Association, written by George Williams, chairman of the Commercial Section. This is abstracted quite fully below, giving succinctly the advantage of membership in this important department of association effort:

What promises to be one of the most beneficial undertakings ever launched under the auspices of the National Electric Light Association is the new Commercial Section. There are by this time probably very few Class B or Class E members of the Association—all of whom are eligible for membership in the new section—who have not heard something of its scope, owing to the systematic manner in which the Membership Committee has been spreading its propaganda. However, there are something like 5,300 eligible persons who have not yet become members, and for the special behoof of these persons the *Bulletin* wishes to call attention to the advantages of belonging to the Commercial Section.

It goes without saying that anything that will increase one's efficiency in his chosen vocation is worth a little investment; and the investment of $2.50 for membership in the Commercial Section can hardly fail to bring manifold returns to any ambitious central-station commercial man, whether he be a specialist on power, distribution, street lighting, sign lighting, refrigeration, or any of the multiform subjects which the Section committees will investigate.

A mere list of the principal committees of the Commercial Section and of their chairmen, together with the statement that these committees will compile and issue publications giving much-needed data on their respective subjects, should be sufficient to emphasize the benefits of Section membership. The committees and their chairmen are as follows:

Committee on Heating, Refrigeration and Kindred Appliance Sales: F. H. Gale, chairman, General Electric Company, Schenectady, N. Y.; Committee on Functions of a Sales Department: T. I. Jones, chairman, Edison Electric Illuminating Company, Brooklyn, N. Y.; Committee on Electric Vehicles: J. T. Hutchins, chairman, General Manager Rochester Railway & Light Company; Committee on Improved Wiring and Wiring Equipment Standards: M. C. Rypinski, chairman, Westinghouse Electric & Manufacturing Company, 165 Broadway, New York; Committee on Residence Business: Clare N. Stannard, chairman, Denver Gas & Electric Company, Denver, Colo.; Committee on Advertising: C. W. Lee, chairman, C. W. Lee Company, 90 West Street, New York City; Committee on Sign Lighting: E. L. Callahan, chairman, H. M. Byllesby & Company, Chicago, Ill.; Committee on Electricity in Rural Districts: John G. Learned, chairman, North Shore Electric Company, Chicago, Ill.; Committee on Industrial Lighting: M. M. Sloan, chairman, Birmingham Railway, Light & Power Company, Birmingfiham, Ala.; Committee on Membership: J. Robert Crouse, chairman, National Electric Lamp Association, 1823 East Forty-fifth Street, Cleveland, Ohio; Committee on Power: E. W. Lloyd, chairman, Commonwealth Edison Company, Chicago, Ill.; Committee on Street Lighting: William Rawson Collier, chairman, Georgia Railway & Electric Company, Atlanta, Ga.; Committee on Competitive Illuminants: H. J. Gille, chairman, Minneapolis General Electric Company, Minneapolis, Minn.

One valuable feature of the Commercial Section is that membership therein is open to manufacturers' representatives as well as to central-station men. It is believed that close co-operation between the manufacturers and operating companies cannot fail to bring about the best of understanding between them in their commercial relations, as well as to cement them in a union of good-

FIG. 4.—INTERIOR OF POWER STATION.

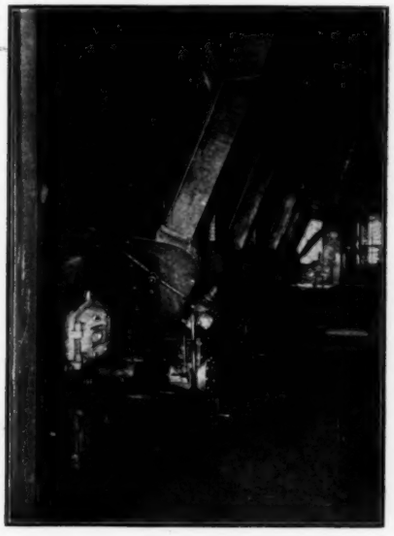


FIG. 5.— STIRLING BOILERS.

will which will insure harmonious progress. It is hoped to make the Commercial Section a model of co-operative efficiency, and to this end members are desired whose ambitions, aspirations and inclinations will lead them to join in a movement which cannot fail to increase their individual efficiency and prestige.

Some of those who are eligible for membership have been heard to ask, "Why should I be expected to pay $7.50 per annum for the privileges and advantages of the National Electric Light Association, when others pay but $5.00?" If the reader is one of those who are of this attitude, we certainly ought to explain to him that the extra $2.50 goes to procure the extra benefits of the Commercial Section, which are rendered only to its members. The question is not one of paying an increased price for existing privileges, but rather of an opportunty to invest in a means of broadening one's viewpoint and increasing one's grasp on the important details of his profession.

A banquet will be given on Monday evening, June 1, at the Hotel Martinique, New York City, to all who have had part in the securing of new members for the Commercial Section. The main feature of the banquet will be the presentation of the sterling silver loving cup donated by J. Robert Crouse to the person who succeeds in securing the largest number of new members.

Applications are coming in in goodly volume, and it is expected that there will be a jubilation at the banquet on June 1. In addition to the committeemen named above, there are a great many members of every department of the industry making a spirited contest for the cup. Application blanks and any desired information regarding the Commercial Section may be obtained from the secretary of the National Electric Light Association, 29 West Thirty-ninth street, New York City, or from J. Robert Crouse, chairman of the Membership Committee, 1823 East Forty-fifth street, Cleveland, Ohio.

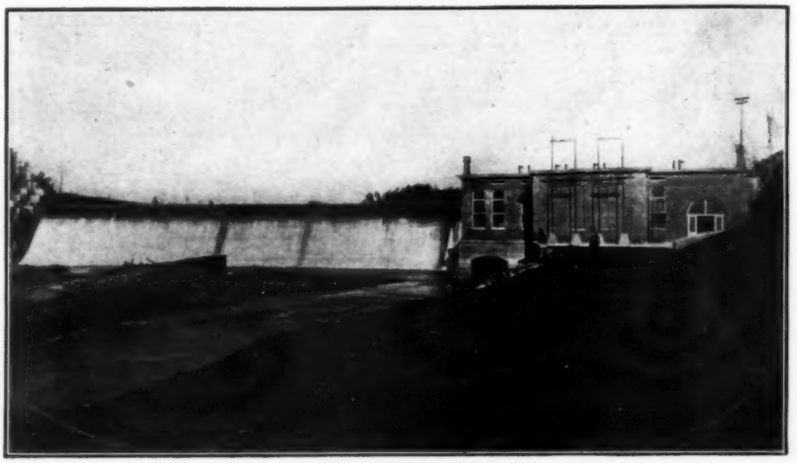
Hydroelectric Development on the Saluda River.

The proper design of a hydroelectric plant is an enterprise requiring the highest engineering skill as well as a thorough knowledge of economic and industrial conditions in the territory to be served by the proposed development. Too often large power houses have been erected with too little preliminary investigation of the low stages of the river furnishing the power during the dry seasons. Contracts have been entered into for supplying electricity up to the nominal capacity of the station and then in times of unusual low water it has been impossible to furnish the amount contracted for. The lessons which the failures should undoubtedly teach are the necessity of careful planning by experts in this line of work and a proper design to best make use of the power available, as well as the most careful study of the possible market.

Of all the factors entering into such an enterprise the last mentioned is probably the most important. It is obvious that low costs per developed horsepower avail not at all if there is no adequate market for the energy produced. Not only must the present conditions of supply and demand be most intimately studied, but the future possibilities should receive an equal share of attention. When properly conceived in this manner, there are few investments more fundamentally solid than a hydroelectric development.

The inherent value of a water power thus developed is well illustrated by the success of a small power plant located on the Saluda River about four miles from Greenville, S. C. The engineers, Lockwood, Greene & Company, of Boston, Mass., made a preliminary survey and examination of the property with the purpose of determining the general characteristics of the proposed development, its approximate cost and the available power. The site of the dam is near the main line of the Southern Railway between Greenville and Atlanta, Ga., and is well situated with regard to obtaining materials by rail. The river slopes uniformly for some distance at this point and on the east side of the river is a high bluff with an outcropping ledge, while at the other side a field rises gradually from the river edge to about the same elevation, thus affording an excellent situation for a dam of sufficient height to flow out the shoals and fill in the stream for several miles above the site, providing a basin of sufficient extent for storage purposes.

The country above the site of the dam is broken and the banks of the stream are generally high with small areas of bottom land, so that the facilities for large artificial reservoirs are rather poor. The entire area of the watershed is about 300 square miles. Test gaugings were made of the stream flow and comparison was made with results from hydraulic developments further down the stream. The government measures showed that the rainfall on this upper portion of the river is from fifty-four to fifty-six inches, proportioned almost equally among the seasons, with a maximum in winter and the driest season in the fall. The lowest reading of stream flow obtained during these investigations was 313 cubic feet per second.



SALUDA RIVER HYDROELECTRIC PLANT.

Allowing, however, for a considerable shrinkage of the lowest gaugings and the known developments, the engineers estimated that the lowest minimum of the driest year might be expected to run as low as 252 cubic feet per second for brief periods.

These figures were based on very careful studies of all available data on the flow of this river, the character of its watershed and by complete surveys and gaugings of the stream. As work was about to commence a member of the engineering staff noticed that the flow of the Saluda seemed unusually small, even for that season of the year, and it was decided to make supplementary gaugings to be sure that the previous low-water estimates were safe to reckon on. It was found that the stream flow was much below any previously recorded dry-season flow, in fact the lowest measured flow of this period proved to be only about one-

half of the estimated dryest season flow. The engineers vouchsafed the opinion that this low stage was so exceptional that it should not be used as a basis for judging the value of the development, but that this value should be estimated on the power available under usual conditions, making allowance, however, for the recurrence of extraordinarily low water by providing sufficient storage capacity to tide over such a period of insufficient flow. Detailed measurements based on a contour map indicated the formation of a storage pond averaging about 600 feet in width at the level of the crest of the dam for seven miles up-stream. The total surface of the pond amounts to 20,000,000 square feet on the contour line through the crest of the dam, and

INTERIOR OF GENERATING ROOM.

two feet variation in height affects this area only about one per cent.

On the basis of a flow of 252 cubic feet per second, the night flow of thirteen hours would amount to 11,793,600 cubic feet; for the storage of which a height of only 6.5 inches is required at the dam. Adding in the Sunday flow, it was found that the greatest height to provide for from the stream flow under usual dry-season conditions, would be eighteen inches on the dam. The engineers further recommended increasing the available head in unusually dry seasons by the use of flashboards of at least three feet in height.

The power available was figured on a working day of eleven hours, six days per week, and on a basis of ordinary dry-season flow, 315 cubic feet per second, amounted to 2,144 horsepower delivered in Greenville. On the basis of 252 cubic feet per second as the minimum dry-season flow; 1,714 horsepower would be available. Figuring from the lowest recorded flow the power available would total 1,006 horsepower delivered. This last estimate is of course only to be expected under extraordinary dry conditions and extra storage capacity was recommended by the engineers for this emergency, as already stated.

A masonry dam to give a head of thirty-seven feet was constructed across the river valley so as to take advantage of the high banks already mentioned, on either side of the river. The natural channel of the river was partially utilized as a raceway from the powerhouse, thus saving a large amount on the cost of the station. The power house itself is at one end of the dam, with its roof about on a level with the bank. The building is, however, sufficiently high to avoid any encroachment by high water in the river below at any season. Five waterwheels, manufactured by S. Morgan Smith Company, were installed, direct-connected to four 600-kilowatt and one 200-kilowatt generators with horizontal shafts. These machines are located in a single row running the length of the operating room.

The main generators are of the Westinghouse revolving-field type and produce three-phase alternating current at 60 cycles and 13,000 volts. The machines have twenty-eight poles and run at 257 revolutions per minute. They are mounted on cast-iron bases supported on concrete foundations at the floor level. They are specified to carry twenty-five per cent overload with an efficiency of not less than 93 per cent under full load and 91 per cent at half load. The 200-kilowatt unit is of the same type as the larger machines and runs at 450 revolutions with an overload capacity of twenty per cent. All the cables from the generators are run in conduits under the cement floor, which is provided with removable sections for the purpose of examination and repairs to the runways.

There are four direct-current exciters provided for in the design of this station. For regular service a 70-kilowatt unit direct-connected to one of the main waterwheels provides excitation for all four of the 600-kilowatt generators and also provides station lighting at 125 volts. Two 35-kilowatt exciters, each capable of supplying two main generators, are belted to the main generator shafts and run at 850 revolutions per minute. There is a 12-kilowatt exciter direct-driven from the shaft of the 200-kilowatt alternating-current generator. This machine excites the fields of the 200-kilowatt machine and also furnishes station lighting when the four main machines are not in use.

On the down-stream side of the power house a projecting compartment extends up to the roof and carries the high-tension transmission lines and switches with their governing apparatus, as well as the generator switches. This is known as the wire tower. On the generator-room side of the tower there are two archways, in which are located the switchboard. This contains nine panels in two sections, five panels for alternating-current generators and two panels for exciter service, set in one bank, while in the second section in another archway are the two panels for outgoing-feeder control service.

The panels are of blue Vermont marble 24 inches wide, 90 inches high, and 2 inches thick, mounted on a wrought-iron angle frame which is securely fastened to the wall at the back and serves to connect the various panels of the board. The main-generator oil switches, which are located in the compartment of the wire tower above the switchboard, are equipped for remote mechanical control by means of a switch lever on the generator panel. These generator switches are all of 100 amperes capacity. Each generator panel also contains one 150-ampere double-pole field discharge switch for the direct-current bus, the field rheostat, as

well as the usual ammeters and voltmeters, plugs, fuses, etc. The fifth generator panel is similar to the other four except that the instruments are for smaller capacities. One of the exciter panels contains the controlling and indicating instruments for the two 35-kilowatt belted exciters, while the second exciter panel carries the instruments for the 75-kilowatt and the 12-kilowatt exciters. Triple-pole knife switches are installed on these panels, also rheostats for the exciter fields and one main station lighting switch.

There are two three-phase three-wire feeders each provided with a separate panel on the board. Each feeder is capable of carrying the entire output of the station or approximately 2,600 kilowatts at 13,000 volts, 200 amperes. The oil switches for controlling these feeders are also located in the wire tower and are equipped for distant mechanical operation from the switchboard. Each are of the plunger oil type and of 200 amperes capacity. Each feeder panel caries one 150-ampere polyphase integrating wattmeter to show the power input to each feeder, three 200-ampere alternating-current ammeters, one per phase, and one alternating-current voltmeter. The usual plugs, fuses, connection posts, are provided.

The busbars are of 98-per cent copper and run in separate cells made of soapstone slabs, 1 :5 inches thick and 12 inches apart. At the top of the wire tower, choke coils are installed on each feeder, as well as horn lightning arresters. The transmission line is carried across country on poles in a nearly direct line to the city of Greenville, where the stepdown transforming station is located.

The cost of the plant entire, including the substation in Greenville and meters, transformers and pole lines to consumers was about $375,000 in round numbers. This figure is undoubtedly high for such developments, but the subsequent history of the plant emphasizes the truth of the fact that first cost is of secondary importance compared with the advantage of a proper location. The plant was erected at a point not only favorable to profitable disposal of its product, but also of strategical importance to the development of the water-power monopoly of that section, the Southern Power Company. So valuable was its position deemed by the controlling factors of the latter corporation that it had been operating but a few years when it was sold out on most satisfactory terms by the original owners. The Southern Power Company is now operating this plant in conjunction with others of their hydroelectric developments in this section of South Carolina. This installation has justified the faith of the engineers in the possibilities of the location for a hydroelectric development and the predicted market in Greenville and its environs has materialized most satisfactorily. Among other results of the completion of this power plant may be mentioned the fact that the street-car and lighting systems of Greenville are now provided with their motive power entirely from this plant and several mills are also purchasing from the power company, one in particular having abandoned a steam plant in favor of purchased electricity.

Apportionment of Expenses.

In view of the recent decisions of public-service commissions and the growing tendency on the part of central-station managers to adopt rate schedules based upon more careful and detailed analysis of operating costs, it seems opportune to inquire into the apportionments of expenses of electric utilities upon which such rates must be based.

It is noted that the opinions in regard to the proper distribution of the cost of service vary so widely that it appears necessary to analyze the apportionments to determine where this difference arises. As a result of a careful study of the several bases it seems evident that the discrepancies are not so much the result of different ideas and views as to the cost analysis as they are the result of classifying the several items of expense under general heads, which heads have not the same meaning in all cases. In other words it appears to be more a question of definition than anything else. A statement of the various terms used in defining and classifying expenses will illustrate this point. A common separation of expenses is that of running and stand-by charges. Again the terms variable and fixed expenses are used. In recent years the terms output, capacity and consumer expenses have come into common usage. It then becomes important to find wherein these terms agree and do not agree; to find out whether they are synonymous.

One definition of the terms fixed and variable as presented by an investigating committee in a municipal investigation of electric rates is as follows: "By fixed charges we mean those charges which would continue unchanged if the production of electricity should be discontinued for a brief period." It would appear then that the governing factor in determining whether an expense is fixed or variable is dependent upon the determination of whether such expenses would continue or discontinue upon the suspension of output. A prominent engineer states: "On every plant the fixed charges, which include interest on first cost, depreciation charges and taxes, continue at a uniform rate every hour of the day and every day of the year." In both definitions the idea of uniformity is evident. Further this authority states: "The operating expenses increase somewhat with the total amount of power furnished but not in proportion." Another authority reads: "Station operating expenses include cost of fuel, water, waste, oil, etc., cost of repairs, labor and attendance. Fixed charges include taxes, interest on investment, depreciation and general office expenses." The Edison Illuminating Company of Boston in a hearing before the Board of Gas and Electric Light Commissioners of Massachusetts approached the determination of what are fixed and variable charges from another standpoint: "Running cost includes only those costs which are reasonably certain to vary with the amount of current made and sold; * * * * all other expenses * * * * are included in fixed costs."

One cannot fail to note in inspecting the different apportionments that have been made, and in analyzing the several definitions that have been offered for the classes of expenses, that the tendency in the main has been to place each separate item of expense entirely under one head or the other. Although the several authorities often acknowledge that their apportionments are not correct for the reason that they have failed to make as accurate divisions as might be made in regard to the separation of certain items over the several classes or heads,

still in general the policy appears to be to charge each item entirely to one class or to the other. The terms fixed and variable, under such conditions, quite often lose any value as actual apportionments to be used in the analysis of costs for rate-making purposes, and simply serve as general heads, each embracing a certain group of cost items.

It is undisputably true that many items of expense are not properly chargeable to one class but should be distributed over the several classes. It would seem better, perhaps, if the definition, "Running costs should include only those costs which are reasonably certain to vary with the amount of current made and sold," should be made to read: "Running costs should include only those costs and portions of costs which are reasonably certain to vary with the amount of current made and sold."

In the terms output, capacity and consumer expenses, which appear to be coming into quite general use and may be said to constitute the foundation of the three-rate systems, there is noted an effort to use terms which are more comprehensive and are subject to more exact and definite determination. Output costs may be defined as those costs which it is reasonably certain do vary with the output of current, bearing in mind that the word costs does not signify an entire item such as repair costs, for example, but only that portion of repair costs which will vary with the current made and sold. In the case of repair costs, the problem of determining what per cent of the expense is proportional to output and what part is a capacity charge is very difficult. Repairs may be due to wear and tear, to careless running, imperfect protection from dust, etc., or to overloading or other causes. Some of these causes bring expenses which can hardly be classified entirely as output costs, because a plant is supposed to be so run and equipped as to be able to meet and handle satisfactorily the demands made upon it. Looking at the plant as a whole comprising many units leads one to the opinion that more of the repair expense is an output cost than at first appears. Where one unit only is used it would appear that a greater proportion of the repair cost is a capacity charge than where several units are in use. Where the units are so arranged and operated as to conform quite closely to the load curve it is clear that the repairs will be more nearly proportional to the current made and sold.

The Ralroad Commission of Wisconsin in practically every decision affecting electric rates has emphasized the importance of a correct apportionment of the operating expenses. The importance of a correct separation of the capacity and output expenses is chiefly found in the fact that in computing the costs per unit for rate-making purposes that part of the expenses which depends upon the demand should be distributed over the demand, or the active load, while that part of the expenses which depends upon the output should be distributed over the sales. In other words, from a theoretical point of view each consumer should contribute to the demand charges in proportion to his demand upon the plant, and he should also share in the output expenses in proportion to the amount of current he uses. Experience shows that it is difficult, if not impossible, to lay down a definition that will apply under all conditions. It is found that the demand or capacity expense is usually a larger proportion of the total expense in the case of a plant operated by water power than where the plant is operated by steam power. The relation is also affected by other conditions. In many instances it has been found that when the demand and output are each charged with all direct items of expense, and when the overhead expenses, such as the costs of management, taxes, depreciation and interest on the investment, are allotted between the demand and the output cost on the basis of the respective sum of the items directly charged to these classes, the results obtained are such that they can be safely used as the basis of rates. In other cases, the most satisfactory results have been obtained when the demand or capacity is charged with the interest on investment, taxes and a few minor items, and the output is charged with the remaining items. The former method is quite commonly used by accountants while the latter method seems to be used by both operators and engineers. There are other methods of separation in use but the two described appear to be the most common, although modified quite often by local conditions.

Peat as a Fuel.

In a country so richly endowed with mineral fuels—coal, petroleum, and natural gas—as is the United States, it would at first glance seem unlikely that peat should ever become a widely used fuel, at least not for many generations. It is true that European countries manufacture peat fuels to the value of $10,000,000 or $12,000,000 annually, but this is done for communities that are remote from coal deposits. However, peat may yet come into considerable local use as a fuel in the United States, and sooner, perhaps, than most people expect.

It is estimated by the United States Geological Survey that of the great unreclaimed swamp area of the United States 8 per cent may constitute workable beds of fuel peat, with a total content equivalent to 12 billion tons of air-dry fuel. It is somewhat singular that the regions containing these peat beds lie almost entirely outside of the territory in which coal and other natural mineral fuels are known to exist in abundance. With the perfection of peat-briquetting machinery these beds may play no inconsiderable part in furnishing at least a supplementary or auxiliary fuel for local consumption. As a fuel peat is no makeshift; it is highly efficient and desirable and the practicability of its use is controlled principally by the cost of production.

In an advance chapter from Mineral Resources for 1909, just published by the United States Geological Survey, Charles A. Davis remarks that in spite of the fact that the use of peat as a fuel has been almost entirely neglected in the United States, there has been nevertheless since 1903 a considerable and persistent interest in the question of utilizing the great peat deposits of the country, and many attempts, some of them involving the expenditure of large sums of money, have been made to place fuel peat on the market in commercial quantities. The failure to bring about this result, Mr. Davis thinks, has been due not to the nature of the peat itself, but to other factors, such as overenthusiasm, lack of understanding of fundamental principles of economical production, too little capital, and too much confidence in poorly designed and untried machinery. The fact that there is a market for peat has not been questioned, for the small quantity of the product offered has always been sold readily and at good prices.

Southwestern Electrical and Gas Association.

Seventh Annual Convention at Houston, Texas, April 27, 28 and 29.

The seventh anual convention of the Southwestern Electrical and Gas Association was held in the City Auditorium, Houston, Texas, on April 27, 28 and 29. There was present the largest attendance ever recorded since the organization of the Association.

The first session was called to order Thursday morning at ten o'clock by President W. B. Tuttle, of San Antonio. City Attorney Wilson welcomed the delegates to the city of Houston. James Dillon, of the *Southwestern Electrician*, responded on behalf of the Association.

The first matter of business to come before the convention was to admit sixty new members to membership, making a total membership of over 400. The president then read his annual address, which is given partially below:

PRESIDENT'S ADDRESS.

I desire to call both your attention, and the attention of our friends, the public, to the intimate relation existing between our business and the growth and prosperity of the various communities in which we operate. In times past there has been in some cases an unfortunate condition in the operation of public utilities. The public has not always had the treatment that it deserved, and the public utilities have been severely, and oftentimes unjustly, attacked. Fortunately, the age of publicity has come, and with a better knowledge of the conditions under which we operate, a different opinion has arisen in the public mind. Formerly the street railway, gas and electric companies never attempted to tell the public that the money they took in day by day was not all profit. They never told the public that they paid out thousands of dollars for labor, and thousands more for fuel and supplies, and thousands more for taxes, and that most of the companies put back more money every year into the towns and growing cities than their entire net earnings. They forgot to tell the public that they extended their lines; that although the price of almost every item of food, dress, dwelling, furniture, luxury and necessity, has increased constantly during the last twenty years, the price of gas, electricity and water had never been raised and in many cases had been materially lessened, although the companies are paying more for labor and supplies. We have been so busy keeping up with the growth of the country and trying to devise ways and means to give better service in answer to the demands of our patrons, and at the same time, in the face of increasing expense in every line, to pay a reasonable return on our investment so that we could keep our property solvent and in condition to give good service, that we have neglected to inform our patrons in regard to our side of the story. Of course, our service is not always perfect, and sometimes we are face to face with congested conditions or lack of proper capacity before we know it, but the same conditions hold true in every branch of private and public enterprise in growing localities, perhaps to a greater extent in many instances than in our business. We are doing a square business in a square way. We are helping build up the country, and giving value received to the people, and when the facts regarding our business are properly understood the people will be square with us, and there will be no objection to our earning a reasonable return upon our investment. The country's growth is essential to us in the development of our business, and our growth and increase in efficiency is essential to the public. We are partners in the closest possible way, and we must regard each other as such.

"Industrial Development of Fuel Gas" was the subject of a paper by R. G. Soper, of the Dallas Company, Dallas, Texas, setting forth the many possible uses of gas as a fuel. After brief discussion, the morning session was adjourned.

The second session of the convention (Thursday afternoon) was opened by the reading of a paper on "Boiler Economy and the Application of Fluegas Analysis" by M. L. Hibbard, engineer for the San Antonio Gas & Electric Company, San Antonio, Texas. After some discussion, E. E. Nelson, electrical engineer of the Northern Texas Traction Company, Fort Worth, Tex., read a paper on "Investigation and Care of Return Railway Circuits."

RAILWAY RETURN CIRCUITS.

It is realized by practically all railway managers today, said Mr. Nelson, that unless extreme care is taken with the return circuits the losses in these circuits will become enormous; even enough to make the difference between a road paying and not paying dividends. Rail steel is a very good conductor. Weight for weight, it is about one-seventh as good a conductor as copper. A copper bar weighing one pound per yard has an area of about 110,000 circular mils, hence an iron bar weighing one pound per yard is equivalent to about 16,000 circular mils of copper, the resistance of which is approximately 0.6 ohm per 1,000 feet. Therefore, the resistance of a steel rail in ohms per 1,000 feet is equal to 0.6 divided by the weight of the rail in pounds per yard, and the carrying capacity of the steel rail in circular-mil copper equivalent is equal to 16,000 multiplied by the weight of the rail in pounds per yard. In order to use this great copper-equivalent carrying capacity, it is necessary to bond the rails themselves electrically together. A rail bond has its greatest resistance where it comes into contact with the rail. If the steel has a resistance of seven times that of copper, the area of the contact between the bond and the rail should be seven times the area of the bond. Copper rail bonds should be flexible enough so that movement of the rail will not damage either the bond or the contact surface between the bond and the rail. An ideal place for installing bonds is underneath the fishplates, fastening the bond terminal into the web of the rail. In this location the bond can be made very short, usually not over ten inches. The shorter the bond the less the resistance of the track return is increased at the joints. Men to work on the bonding gangs should be selected with great care. Only such men should be used as are able to be taught how to install them. If there is a great deal of current leakage from the rail to the ground, it will be found that the base of the rail will wear out, due to corrosion, much faster than the head. In fact, if this leakage is too much, the base of the rail will be damaged in a short time so that it cannot be spiked to ties. Salts will increase this corrosive effect. It has been found that ties treated by the chloride of zinc process to prevent decaying, will, when used under rails carrying electric current of 100 to 200 amperes, cause the base of the rail to be eaten away in three years' time, so that the rails are practically useless. To sum up, it can be stated that satisfactory return circuits are only possible with first-class track bonding. Poor bonding workmen will spoil the best bond ever made. Care should be used in the purchase of track bonds, and the greatest care should be used in their installation. Periodically, thoroughly reliable men should test and repair all bonding.

M. L. Hibbard, of San Antonio, opened the discussion by explaining some tests he had made. H. S. Cooper, of Galveston, suggested that the leakage from the rail to the ground could not be entirely eliminated. Mr. Nelson closed the discussion by stating, in reply to a question, that he had never had any success with soldered rails in the matter of bonding, and that he was not in favor of this method.

L. B. Moorehouse read a paper on "An Investigation of the Steam Consumption of Water-gas Plants" which closed the session for the afternoon.

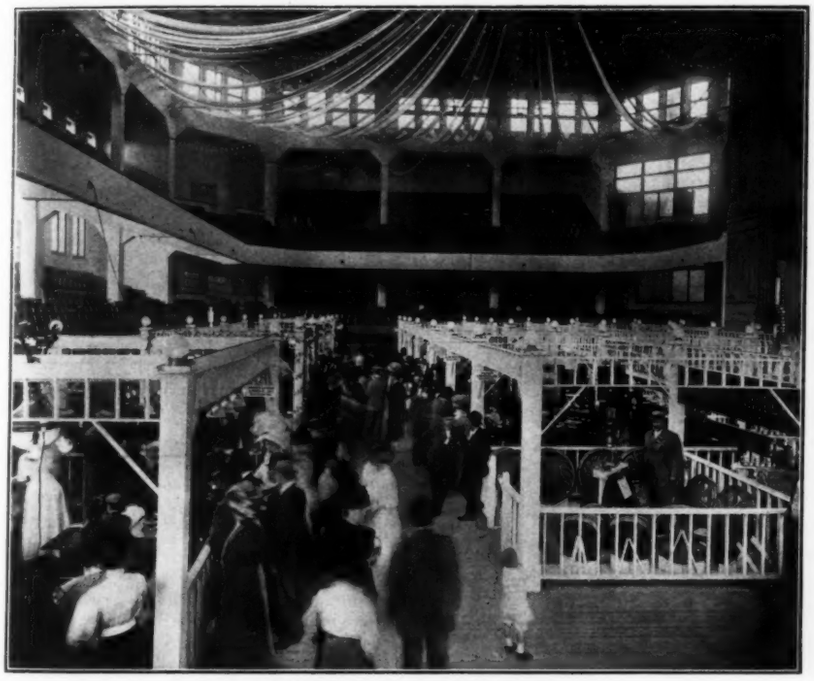
Owing to the inability of President Tuttle to be present, J. E. Carroll, first vice-president of the Association, presided during the remainder of the sessions, beginning with that of Friday morning, when a paper by C. W. Kellogg, Jr., manager of the Texas securities department, Stone & Webster, on "The Cause and Prevention of Accidents," was the first to be presented. We can only call attention to the salient points, as the paper dealt with this subject in a most thorough and comprehensive manner.

CAUSE AND PREVENTION OF ACCIDENTS.

Equipment. From the investigation of five of the larger street-railway companies in Texas, the prepayment type of car in comparison with practically all other makes has proved to be the best for the prevention of street-car accidents. With the increasing amount of noise and traffic, the matter of furnishing adequate gongs is very important. The repeating gong which can be used on any car has been found very effective. In view of the modern devices in the form of fenders and life-guards, Mr. Kellogg does not think street-railway companies are justified in neglecting to install some apparatus of this nature. Life-guards installed on the

trucks of cars which trip automatically as soon as any object is encountered on the track are now manufactured in a form which is practically certain in its operation, and simple and easy to maintain. In several cities small mirrors are placed at the corner of the front vestibule in such a position that the motorman by glancing into it can see back along the side of the car in order to ascertain whether any one is in the act of boarding or alighting before he starts the car. The companies which have no gates or doors on their car platforms find these mirrors a great help in accident prevention. All cars should be equipped with automatic circuit-breakers or some device for interrupting the flow of current. New designs of controllers have a contactor device which renders arcing between points almost impossible.

Human Element. It is wrong to assume that a new man is necessarily more of an accident breeder than a man old in the service; and that trainmen as a class have no sense or they would not be on the job.



EXHIBITS IN CITY AUDITORIUM.

The handling of a car in such a way as to avoid accidents is one of the fundamentals that should be taught the new men; and all the men should be made to understand that an instructor is available for old men as well as for new. Proper patience and perseverance should be exercised in instructing the men to avoid accidents.

The Public. The accident situation involves: in the first place, the education of all the public to greater care; in the second place, their carelessness arises principally from thoughtlessness which prevents educational efforts from having a lasting effect. In the northwestern part of the country a very interesting movement has been started within the last few months, known as the Public Safety League. A paid lecturer visited the schools and gave each pupil a small white pennant with the letters "P. S. L." on it. Inquiry from other persons as to what these letters meant served to pass the word along to friends and parents. In the city of Seattle alone there were 50,000 of these badges distributed.

Electric Lighting Company Accidents. It is easy to dismiss from our minds as due to carelessness a sad accident to a lineman or an arc trimmer getting killed while engaged in his work, but this is not enough. It seems only fair that in addition to the usual equipment including the insulated stool, that postive cutout hangers should be furnished. Mr. Kellogg believes the final result obtained in reducing accidents is the cumulative effect of dozens of details.

T. C. Brown, of San Antonio, opened the discussion by saying that as a matter of operation for the first year he would prefer that street cars should not be equipped with gongs. It is a mistake on the part of motormen to think they can shoo people off the track with a gong. He has found that the man that touches the gong the fewest times has the fewest accidents. Mr. Wood, of Texarkana, held somewhat opposite views, stating that because of the failure of a motorman to ring the gong a judge had instructed a jury to find against a company, even though the motorman exercised every power and every other means at his command. He stated further that the installation of powerful headlights had almost entirely eliminated night accidents; a car can be seen for several blocks away. He has an inspector that rides on the cars nearly all the time and whose duty it is to report passengers that continually take chances. Mr. Wood warns them in letters that unless they desist they will surely get hurt. Such letters had won at least three cases for him. Trainmen off duty attend court and listen to the testimony and arguments of counsel especially. This has produced very good results.

P. A. Rogers, commercial agent for the Dallas Electric Light & Power Company, read a paper on "The Development of Power Business." An extract from this paper follows:

DEVELOPMENT OF POWER BUSINESS.

In building up power business there is required personal solicitation and education of the prospect. Prospects may be divided into two classes, the large and the small consumer. In getting customers in the first class it is largely a matter of making a rate lower than they can get power from other sources. The second class comprises the greatest number as well as the greatest aggregate of horsepower and thereby offers the best field for development. The small consumer starts into business with a feeling of suspicion if not even prejudice against the power company, and seventy-five per cent of the effort required to obtain the business of the prospect is spent in overcoming this suspicion or prejudice. The solicitor should investigate the needs of the prospect and decide what is the best equipment and obviate the confusion on the part of the customer by deciding beforehand what is best for him.

Mr. Cushman, of San Antonio, opened the discussion by asking Mr. Rogers if he did not often find some large power prospects able to produce power cheaper than the electric company, to which Mr. Rogers replied that where he found such a condition of affairs the argument he offered was on the first cost of the space and equipment of the isolated plant.

John I. Beggs, former president of the Milwaukee Electric Railway & Light Company, made a brief address at the opening of the Friday afternoon session, in which he paid tribute to the splendid work of the Southwestern Electrical and Gas Association and to the rapid development of the Texas cities. Papers were read by R. T. Sullivan on "Light-weight Cars" and W. H. Riblet on "Naphthalene," which concluded the program for Friday.

The Saturday morning session was opened by the report of the secretary, showing a total attendance of 528, and a membership of 400. A vote of thanks was tendered D. G. Fisher, the secretary, for the excellent work he had done. The following officers were elected for the ensuing year:

President, Joe E. Carroll, of Beaumont, Tex.

First vice-president, E. T. Moore, of Dallas, Tex.

Second vice-president, D. G. Fisher, of Dallas, Tex.

Third vice-president, H. M. Moore, of Austin, Tex.

Treasurer, A. E. Judge, of Tyler, Tex.

Secretary, D. G. Fisher, of Dallas, Tex. (re-elected).

Fort Worth and San Antonio, Tex., were the cities suggested by the members as the next meeting place, the final selection resting with the Executive Committee.

ENTERTAINMENT.

The first entertainment feature was the formal opening by Mayor Rice of Houston and the officers of the Southwestern Electrical and Gas Association of the first electrical show in the new Municipal Auditorium at 1:30 p. m., Thursday. In the evening there was a general reception at the electrical show.

The ladies were entertained at the Country Club at luncheon on Thursday, and attended the Majestic Theater Friday evening.

A rejuvenation of the Sons of Jove took place Friday evening, at which forty new members were initiated. Statesmen Binz, Martin, Stroud and Richards; Ninth Jupiter Dostal; E. D. Strickland, assistant to Jupiter; Charles Newning, Sam Hobson and E. L. Walls, Jr., were some of the leading men of the order who were present. Mr. Newning, one of the founders of the Jovian order, was presented with a loving cup.

The main feature of the entertainment occurred Saturday, when the delegates rode down the bayou about sixteen miles to the famous battlefield San Jacinto. The battle of San Jacinto was fought April 21, 1836, just after the capture of the Alamo, at which time Sam Houston with an army of 782 captured Santa Anna with an army of 1,400, winning for Texas her independence from Mexico.

A unique feature of the convention was the annual souvenir program, published by the Executive Committee, which this year is extremely artistic. It is bound together with orange satin ribbon, the outer casing being of Japanese silk paper, while the title page and back folder are of a splendid texture of linen vellum. The fly page bears, in green and gold, the superscription of the Association. The booklet of 115 pages contains a concise history of the Association, the program of the seventh annual convention, roster of members, advertisements, officers and committees and a "Question Box," containing fifty-one pages of questions and answers. Each year an improvement has been noted in the quality of workmanship and material of this fine annual publication.

THE EXHIBITORS.

The City Auditorium proper was the scene of a very attractive and interesting exhibition of the latest appliances pertaining to both gas and electricity. The color scheme throughout was white, red and green, and was carried out with much artistic skill and taste. The general scheme was balustrade work in white and at the junction of each booth was a white column surmounted by a white eight-inch globe containing a red incandescent lamp. About 30,000 people visited the show. A list of the exhibitors follows:

Westinghouse Electric & Manufacturing Company.
General Electric Company.
Simplex Electric Heating Company.
Southwestern Telephone & Telegraph Company.
Houston Car Wheel Foundry.
Wagner Electric Company.
John A. Roebling & Sons.
Atlas & Ruay Supply Company.
The Tool Steel Gear & Pinion Company.
The Texas Company.
Randall-Lovegrove-Wyman Company.
Southwestern Electrician.
Crocker-Wheeler Company.
Automatic Telephone Company.
Electric Service Supply Company.
Goldschmidt Thermit Company.
Dixon Car Wheel Company.
Brown-Woods Electric Company.
Houston Light & Power Company.

Program of the National Electric Light Association Convention.

The business program of the thirty-fourth convention of the National Electric Light Association, to be held at the Engineering Societies Building in New York City on May 29 to June 2, inclusive, has been quite definitely mapped out, although it is still subject to slight alterations. It shows clearly, however, that the work of the convention will be strenuous. In the four days given over to the convention proper there will be sixteen sessions. On each of Wednesday, Thursday and Friday mornings there will be three parallel sessions, and on Wednesday and Thursday afternoons there will be two parallel sessions. There are twenty-four papers on the program and nearly forty committee reports. In all there are some seventy items in the order of business and it will take the full time of the convention to dispose of them. The last day, Friday, will probably be the busiest day of all. As usual the papers and committee reports are associated with the names of many leaders of the central-station industry.

The program is as follows:

TUESDAY MORNING, MAY 30.

First General Session.

Welcome to New York City.
President Freeman's Address.
Announcements.
Report of Committee on Membership—H. H. Scott, Chairman.
Report of Committee on Progress—T. C. Martin, Chairman.
Paper—"Master and Men"—Paul Lüpke.
Report of Accounting Committee—John L. Bailey, Chairman. (Referred to Accounting Session.)
Report of Committee on Overhead Line Construction—Farley Osgood, Chairman. (Referred to Technical Session.)

TUESDAY EVENING.

Public Policy Committee Report on Plan of Welfare Work.

WEDNESDAY MORNING, MAY 31.

First Technical Session.

Report of Overhead Line Construction Committee—Farley Osgood, Chairman.
Report of Preservative Poles Committee—W. K. Vanderpool, Chairman.
Report of Underground Construction Committee—W. L. Abbott, Chairman.
Report of Meter Committee—G. A. Sawin, Chairman.

First Accounting Session.

Report of Committee—Chairman Bailey.
Paper—Tracing Store-room Material—John T. Brady.
Paper—The Purchasing Department—T. W. Buxton.
Paper—Advantage of a Job-cost System—Alec. Holme.

First Commercial Session.

Address of Chairman George Williams.
Report of Committee on Electricity in Rural Districts—J. G. Learned, Chairman.
Report of Committee on Power—E. W. Lloyd, Chairman.
Report of Committee on Electric Vehicles—J. T. Hutchings, Chairman.

WEDNESDAY AFTERNOON.

Second General Session.

Paper—Electrical Exhibitions—Louis A. Ferguson.
Report of Insurance Expert—W. H. Blood, Jr.
Report on Bulletin and Question Box—M. S. Seelman, Jr., Editor.
Report of Library Committee—A. Williams, Chairman.
Report on Solicitors' Handbook—A. Williams, Editor.
Report of Secretary—T. C. Martin.
Report of Treasurer—George H. Harries.
Paper—Company and Company Section Bulletins—E. A. Edkins.
Topical Discussion on the Work of the Company Sections.
Appointment of Nominating Committee.

Second Accounting Session.

Paper—Handling Customers' Orders—R. F. Bonsall.
Paper—The Collection of Bills—E. J. Bowers.
Paper—Electric Vehicle Accounts as Applied to a Department of a Central-station Plant—Herman Spoehrer.

THURSDAY MORNING, JUNE 1.

First Power Transmission Session.

Report of April Conference on Governmental Control of Water Powers—Chairman Henry L. Doherty.
Paper—Utilization of Central Stations for Supplying Electricity to Operate Railroads—Fred Darlington.
Report of Committee on Protection from Lightning—B. E. Morrow, Chairman.

Second Commercial Session.

The morning will be devoted to an Executive Session of the Members of the Commercial Section, when a number of important matters will be discussed.

Third Accounting Session.

Paper—General Office Accounting—Franklin Heydecke.
Paper—Depreciation—H. M. Edwards.

Paper—The Extent to Which a Tabulating Machine Can Be Used in Accounting Work—Wm. Schmidt, Jr.

THURSDAY AFTERNOON.

Second Technical Session.

Report of Committee on Prime Movers—I. E. Moultrop, Chairman.
Report of Lamp Committee—W. F. Wells, Chairman.
Report of Committee on Electrical Apparatus—L. L. Elden, Chairman.
Paper—Ventilation of Turbo-generators—R. B. Williamson.
Paper—Progress and Development in Self-cooled Transformers—H. O. Troy.

Third Commercial Session.

Report of Committee on Residence Business—Clare N. Stannard, Chairman.
Report of Committee on Improved Wiring and Equipment Standards—M. C. Hypinski, Chairman.
Report of Committee on Industrial Lighting—M. S. Sloan, Chairman.
Report of Committee on Electric Heating, Refrigeration and Kindred Appliance Sales—Frank H. Gale, Chairman.

FRIDAY MORNING, JUNE 2.

Third Technical Session.

Report of Committee on Grounding of Secondaries—W. H. Blood, Jr., Chairman.
Paper—Grounding Low-tension Circuits—P. M. Lincoln.
Paper—Recent Important Improvements in Single-phase Motors—H. A. Layman.
Paper—Relation of Motor Load to Station Equipment—F. D. Newbury.

Second Power Transmission Session.

Paper—A New Method of Reducing the Investment in Central-station Boiler Plants—M. A. Wagner.
Paper—Determining Cost of Production in Steam Properties under Varying Conditions—George H. Walbridge.
Topical Discussion on Methods of Operating Transmission Systems.

Fourth Commercial Session.

Report of Committee on Electric Signs—E. L. Callahan, Chairman.
Report of Committee on Advertising—C. W. Lee, Chairman.
Report of Committee on Competitive Illuminants—H. J. Gille, Chairman.
Report of Committee on Functions of a Sales Department—T. I. Jones, Chairman.

FRIDAY AFTERNOON.

Third General Session.

Report of Committee on Rate Research—John F. Gilchrist.
Paper—Valuation of Properties as Related to Rates—W. F. Wells.
Paper—Reasons for Variations in Rates under Varying Conditions of Operation—N. T. Wilcox.
Paper—The Standardization of Electrical Selling—Douglass Burnett.
Paper—Economies in Operation Possible Through Time Study—L. B. Webster.
Report of Committee on Memorials—T. C. Martin.
Report of Committee on Form of Section Organization—Frank W. Frueauff, Chairman.
Vote on Changes in Constitution.
Report of Nominating Committee.
Election of Officers.

American Society for Testing Materials.

The fourteenth annual meeting of the American Society for Testing Materials will be held at the Hotel Traymore, Atlantic City, N. J., June 27 to July 1. The program is in an advanced state of preparation, and it is proposed to print the papers and reports in advance.

THE DENSITY OF COPPER.

BY J. H. DELLINGER.

In the usual engineering or commercial tests of electrical resistivity of copper, the quantities measured are resistance, mass, and length. The resulting constant is the "mass resistivity" (defined as the product of resistance per unit length and mass per unit length), which may be given either in "ohms per meter-gram" or "ohms per mile-pound" (the latter is sometimes called "pounds per mile-ohm"). In textbooks we find very little about the "mass resistivity," and much about the "volume resistivity" or resistance of a unit length and unit cross-section, which in the past has been generally known by the unfortunately chosen term "specific resistance." The commercial practice of measuring the mass per unit length rather than the cross-section, is strictly proper, because (1) copper is sold by weight rather than by volume, and therefore the information of value to most users is given directly by the mass resistivity, (2) the measurement of mass is a more accurate and an easier operation than the measurement of cross-section of a wire of variable diameter, as all wires are, (3) the density of copper is usually considered to vary so little that the volume resistivity can be calculated for a sample by the use of a standard value for density.

Of course, when it is desired to calculate the resistance of a particular wire from its dimensions, it is necessary to know the density in addition to the mass resistivity. The density is the connecting link between mass resistivity and volume resistivity, the former being proportional to the product of the latter into the density. It is the purpose of this article to present some data on the density of copper used for conductors, obtained at the Bureau of Standards in connection with the recent investigations of the temperature coefficient and the conductivity of copper. The average value from all the data is the figure which has been most frequently used in the past as a standard value, *viz.*, 8.89 (at twenty degrees centigrade). The data may be conveniently divided into three parts.

First, the density has been determined, in most cases by the author, on a number of the wire samples submitted to the Bureau of Standards for ordinary conductivity tests by various companies. During the three years, 1908-1910, the density of thirty-six such samples was determined. These samples had been submitted by seven companies, as follows, three smelters, three electrolytic refiners, one user of copper who bought his material from various copper companies. The number of samples and the mean density, for each of these companies, is shown in the following table:

Number of Samples.	Density.
8	8.882
2	8.892
3	8.869
3	8.895
4	8.918
12	8.872
4	8.878
Mean	8.887

All of the thirty-six samples were of conductivity greater than 97.5 per cent, except one of the samples in the fourth group, for which the conductivity was 94.6 per cent and the density was 8.887.

The second group of data is that obtained from the wires which were included in the recent investigations of the temperature coefficient and resistivity of copper. Inasmuch as the "mass resistivity" was considered the important quantity rather than the "volume resistivity," it was not necessary in the investigation to determine the density. However, measurements on a few samples from three of the companies whose copper was included in the investigation were made by the author, and data were obtained by Geo. L. Heath, of the Calumet and Hecla Smelting Works, on eighteen samples of copper, a number of which were included in the Bureau of Standards investigation. The results, for the four companies, are summarized in the following table:

Number of Samples.	Density.
3	8.880
1	8.895
1	8.900
18	8.899
Mean	8.893

All of these samples were of conductivity greater than 95 per cent.

The third group of data is that obtained at the Physikalisch-Technische Reichsanstalt, of Germany, by Professor Lindeck, and given in the appendix of the author's paper on "The Temperature Coefficient of Resistance of Copper."[1] These results are for copper samples submitted for test at the Reichsanstalt during the five years,

1 *Bulletin* of Bureau of Standards, Vol. 7, No. 1; abstract in ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, 56 p. 933, May 7, 1910.

1905-1909. The mean value of the density for the forty-eight samples is 8.890. Some of these samples were of low conductivity, down to one-third of the conductivity of pure copper. Taking only the thirty-four samples of conductivity greater than ninety-four per cent, the mean value of the density is 8.881.

The final average value may be computed from the three groups of data in the following way, for example:

B. S. tests	8.887
B. S. investigation	8.893
Reichsanstalt	8.890
Final average	8.890

Or, if we use the Reichsanstalt value for only the samples whose conductivity exceeded ninety-four per cent, we have:

B. S. tests	8.887
B. S. investigation	8.892
Reichsanstalt	8.881
Final average	8.887

Or, if we consider the Calumet and Hecla measurements and the other measurements of the second group as independent means, and again use the Reichsanstalt value for only the samples whose conductivity exceeded ninety-four per cent, we have:

B. S. tests	8.887
B. S. investigation	8.893
Calumet and Hecla	8.899
Reichsanstalt	8.881
Final average	8.890

For any reasonable method of calculating the final average, we find that, to three significant figures, the value is 8.89. Since, in addition to the weight of the foregoing evidence, this value has been very widely used as standard, there seems to be no doubt that it is the best figure to assume for the density of copper at twenty degrees centigrade.

In justification of the assumption made in engineering practice that the variations of the density of particular samples of copper from the standard mean value do not exceed the limits of commercial accuracy, the data on the samples discussed in the foregoing show that the density is usually between 8.87 and 8.91, that in a few cases it varies as far as 8.85 and 8.93, and that in extreme cases it can vary to 8.83 and 8.94. We are here referring to copper of conductivity greater than ninety-four per cent.

The question sometimes arises whether there is any difference in the density of annealed and of hard-drawn copper. That there is no appreciable difference was shown by experiments made by Mr. Heath on the eighteen wires mentioned above, which were of 80 mils and 104 mils diameter (No. 10 and No. 12 A. W. G.). The mean density of eight annealed samples was 8.899. The mean density of ten hard-drawn samples from the same coils was 8.898. After these hard-drawn samples were annealed, their mean density was 8.900. The very small differences between these three means are too small to be considered significant. The densities of all the eighteen samples varied from 8.878 to 8.916.

In conclusion, it is desired to point out that confusion sometimes arises over the different ways of specifying density and "specific gravity." In a recent case, this led to a criticism of the value, 8.89 for density, as being too low a figure. The critic, however, had in mind the "specific gravity referred to water at twenty degrees centigrade." Density, defined as the number of grams per cubic centimeter, is identically equal to "specific gravity referred to water at its maximum density." A "specific gravity referred to water at twenty degrees centigrade" of 8.91 is equal to a density, or "specific gravity referred to water at its maximum density," of 8.8946. It is apparent that the term "specific gravity" is not definite unless it be stated to what temperature of water it is referred. Since varying interpretations cannot be given the term *density*, this is the preferable term. Of course, since a metal expands as its temperature rises, its density decreases. Thus, if the density of copper is 8.89 at twenty degrees centigrade, it is 8.90 at zero. Consequently, when we speak of either density or specific gravity, the temperature of the substance whose density we are giving should be specified. Finally, then, the density of copper has been found to be 8.89 at twenty degrees centigrade.

German Incandescent-Lamp Industry.

During 1910, Germany imported 74 tons of incandescent lamps, valued at $220,150, against 135.7 tons, worth $403,648, in 1909; and shipped to foreign purchasers 1,978.2 tons, valued at $11,527,768, in 1910, and 1,655.2 tons, worth $8,666,532, in 1909. Austria-Hungary and the Netherlands supplied most of the imported lamps, and the United Kingdom, Russia, France, Austria-Hungary, Italy, Argentina, Switzerland, and Belgium received the larger part of Germany's exports of these goods.

During the last six months of 1910, separate but incomplete statistics were kept of the number and kind of the incandescent lamps exported. During this period there were shipped 20,691,543 incandescent lamps, weighing 969.5 metric tons, in addition to 57.3 metric tons of lamps that were not counted or classified. Among the total number counted, 5,741,106 were carbon-filament lamps, 14,847,320 were metal-filament lamps, 11,958 were Nernst lamps, and 91,159 lamps not specified.

The recently imposed German Government tax upon lamps and all lighting apparatus has had a detrimental effect on the associated industries. The domestic consumption of all lamps has very materially decreased since the new law went into effect. Not only people in private life, but factory owners, hotels and restaurants, and other large consumers of gas and electric lamps had supplied themselves for months in advance in anticipation of the new tax. Moreover, the lamps now appear to be used more carefully than formerly and hence last longer.

Johns Hopkins Lecture on Illuminating Engineering Published.

The Johns Hopkins Press, Baltimore, Md., has published the lectures on illuminating engineering that were delivered last fall at Johns Hopkins University under the joint auspices of the University and of the Illuminating Engineering Society, and which aroused so much attention at the time. The lectures appear in two octavo volumes with a total of 1,052 pages. The illustrations, of which there is a total of about 430, are excellent, as also is the presswork. By the use of thin paper the thickness of each book has been kept to one inch.

The lecture course consisted of thirty-four lectures given by twenty-three lecturers selected among scientists, engineers and leaders of the varied industries concerned with lighting and illumination. The lectures covered practically every phase of the science and art of illuminating engineering. The matter presented and now so happily put into permanent form is the most complete compilation of our present knowledge of the subject and the two volumes of lectures will therefore be used extensively for reference.

Specifications of the National Electrical Code for Rubber-Covered Wire.

With the idea of securing a greater degree of safety in wiring installations, the electrical committee of the National Fire Protection Association which succeeded the Underwriters' National Electric Association, drafted a new set of specifications for rubber-covered wire at its biennial meeting in New York on March 23. Under the new specifications the wire must pass not only a physical, but also a chemical test.

The changes in the specifications of code 41-45, affecting the covering of wire, are given herewith:

"Rule 41, Section b.—The insulation must consist of a rubber compound, homogeneous in character, adhering to the conductor or to the separator, if one is used, and of a thickness not less than that given in the following tables Nos. 41 e and f.

"Rule 41, Section c.—Any one-foot sample of completed covering must show a dielectric strength sufficient to resist throughout five minutes the application of an electromotive force proportionate to the thickness of insulation in accordance with the following table:

Thickness in 64ths inches	Breakdown test on 1 foot
1	3,000 volts A. C.
2	6,000 " "
3	9,000 " "
4	11,000 " "
5	13,000 " "
6	15,000 " "
7	16,500 " "
8	18,000 " "
10	21,000 " "
12	23,500 " "
14	26,000 " "
16	28,000 " "

"The source of alternating electromotive force shall be a transformer of at least one-kilowatt capacity. The application of the electromotive force shall first be made at 3,000 volts for five minutes, then the voltage increased by steps of not over 3,000 volts, each held for five minutes, until the rupture of the insulation occurs. The tests for dielectric strength shall be made on a sample wire which has been immersed in water for seventy-two hours. One foot of the wire under test is to be submerged in a conducting liquid held in a metal trough, one of the transformer terminals being connected to the copper of the wire and the other to the metal of the trough.

"Rule 41, Section d.—Every length of completed wire or cable must be tested after not less than twelve hours immersion in water and while still immersed by the application for one minute of an alternating-current voltage derived from apparatus of ample capacity, the test voltages to be those given in the tables of 41 e and f.

"After this voltage test every length of completed wire or cable, while still immersed, must show an insulation resistance after one minute electrification not less than the values given in 41 e and f.

"Any length of completed wire or cable may be tested during thirty days' immersion in water and must show not less than fifty per cent of the insulation resistance required after the twelve hours' immersion.

"The results of insulation test at different temperatures to be reduced to a basis of sixty degrees Fahrenheit (15.5 degrees centigrade) by using the multipliers in the following table:

Temp. Degs. Fahr.	Multiplier.
50-52	.69
53-55	.78
56-58	.88
59-61	1.00
62-64	1.12
65-67	1.27
68-70	1.43
71-73	1.60
74-76	1.81
77-79	2.04
80-82	2.29
83-85	2.58

"Rule 41, Section e.—Thickness of insulation, voltage tests and minimum insulation resistance to be in accordance with the following tables. The test voltages are to be for one minute. The insulation resistances are after one minute electrification and at sixty degrees Fahrenheit.

TESTS ON COMPLETED LENGTHS 0-600 VOLT CLASS. TYPE LETTERS R. S.

Size	Thickness of Insulation	Megohms per mile after 12 hrs. immersion	Voltage Test one minute
14	3-64	300	1,500
12	3-64	250	1,500
10	3-64	225	1,500
8	3-64	200	1,500
6	1-16	200	2,000
4	1-16	150	2,000
2	1-16	125	2,000
1	5-64	150	2,500
1-0	5-64	125	2,500
2-0	5-64	125	2,500
3-0	5-64	100	2,500
4-0	5-64	100	2,500
225,000 C.M.	3-32	100	3,000
300,000 "	3-32	100	3,000
400,000 "	3-32	100	3,000
500,000 "	3-32	100	3,000
600,000 "	7-64	100	3,500
700,000 "	7-64	100	3,500
800,000 "	7-64	100	3,500
900,000 "	7-64	100	3,500
1,000,000 "	7-64	100	3,500
1,250,000 "	1-8	100	3,500
1,500,000 "	1-8	75	3,500
1,750,000 "	1-8	60	3,500
2,200,000 "	1-8	50	3,500

"Rule 41, Section f.—Tests on completed lengths, 601 to 7,000 volt classes.

MAXIMUM OPERATING VOLTAGE.
1,500 V. TYPE LETTER R. S.—15.

Size	Thick Ins.	Ins. Res. Meg.	Volts Test
B. & S. Gage			
14-8	1-16	600	4,000
7-2	5-64	300	"
1-4-0	3-32	200	"
Circular Mils.			
225,000-500,000	7-64	175	"
525,000-1,000,000	1-8	150	"
Over 1,000,000	9-64	100	"

MAXIMUM OPERATING VOLTAGE.
2,500 V. TYPE LETTER R. S.—25.

Size	Thick Ins.	Ins. Res. Meg.	Volts Test
B. & S. Gage			
14-8	3-32	700	6,250
7-2	3-32	350	"
1-4-0	7-64	250	"
Circular Mils.			
225,000-500,000	1-8	200	"
525,000-1,000,000	9-64	175	"
Over 1,000,000	10-64	125	"

MAXIMUM OPERATING VOLTAGE.
3,500 V. TYPE LETTER R. S.—35.

Size	Thick Ins.	Ins. Res. Meg.	Volts Test
B. & S. Gage			
14-8	4-32	850	8,750
7-2	4-32	450	"
1-4-0	4-32	300	"
Circular Mils.			
225,000-500,000	9-64	225	"
525,000-1,000,000	10-64	200	"
Over 1,000,000	11-64	150	"

MAXIMUM OPERATING VOLTAGE.
5,000 V. TYPE LETTER R. S.—50.

Size	Thick Ins.	Ins. Res. Meg.	Volts Test
B. & S. Gage			
14-8	6-32	1,000	12,500
7-2	6-32	650	"
1-4-0	6-32	450	"
Circular Mils.			
225,000-500,000	6-32	300	"
525,000-1,000,000	6-32	225	"
Over 1,000,000	7-32	175	"

MAXIMUM OPERATING VOLTAGE.
7,000 V. TYPE LETTER R. S.—70.

Size	Thick Ins.	Ins. Res. Meg.	Volts Test
B. & S. Gage			
14-8	8-32	1,200	17,500
7-2	8-32	800	"
1-4-0	8-32	550	"
Circular Mils.			
225,000-500,000	8-32	400	"
525,000-1,000,000	8-32	275	"
Over 1,000,000	9-32	200	"

"Rule 41, Section g.—Lead-covered wires and cables for interior work only.

"Construction of lead-sheath rubber-insulated conductors 0-600 volts. Thickness of insulating wall same as for braided cables, all cables to be covered with a compound-filled tape or braid over the insulating wall. If braid is used, it shall be of such a thickness as to increase the required diameter over the insulating wall by at least one-thirty-second of an inch, and must comply with the requirements for braid on braided conductors.

"If tape is used it must not be less than one-sixty-fourth of an inch thick and must lap at least one-fourth of its width. The width of the tape used should not exceed twice the square root of the diameter of the conductor over the insulating wall; i. e., 500,000-circular-mil three-thirty-seconds rubber, tape not to exceed two inches in width; No. 14, three-sixty-fourths rubber, tape should not exceed .8 inch in width.

"The lead on single-conductor cables, 0.600-volt class, sizes 2 B. & S. and smaller, both solid and stranded, to be not less than the thickness of rubber called for by Rule 41e. On larger sizes

the thickness of lead to be not less than the thickness of insulating wall called for, less one-sixty-fourth of an inch; i. e., thickness of lead on No. 2, one-sixteenth inch; on 1,000,000 circular mil, three-thirty-second inch. On multiple conductor cables, thickness of lead to be that called for by single conductor, having same diameter over the insulation as the multiple-conductor cable has over the bunched insulated conductors.

"Rubber-insulated and lead-sheathed cables, 601 to 7,000-volt classes inclusive, shall comply with Rule 41-f, and the lead sheath shall be the same as called for in 0-600-volts class, having same diameter under the lead as 601-7,000-volt conductor.

"Electrical test on finished leaded cables the same as on braided.

The section regarding the physical tests to be carried out now reads as follows:

"Rule 41, Section h.—'General' 41-h: (Fine print note.) All physical tests to be made at a temperature between sixty degrees and ninety degrees Fahrenheit. All test samples to be kept at a temperature within this range for at least two hours before the tests are made.

"1. The rubber compound or other approved insulation must be sufficiently elastic to comply with a test made as follows:

"A sample of wire about twenty inches long shall have the braid and insulation removed for about two inches at each end, leaving the braid and insulation on balance of sample. One end of the bare copper should be fastened to a clamp on a shaft of the diameter given below, and a weight as given below attached to the other end of the bare copper wire. The shaft shall then be revolved ten times in ten seconds, wrapping the sample in a close wind around the shaft. With the tension left on the sample, it should then be immersed in water for twenty-four hours, immediately after which it should, while still immersed, be subjected to 1,500 volts alternating current for one minute. The braid shall not crack under the above test.

Diam. of shaft	B. & S. No. 14 wire	Mils. 170	Lbs. weight 10
" "	12 "	190	" 10
" "	10 "	275	" 12
" "	8 "	375	" 15

"2. The insulating covering shall be tested for softness as follows:

"A sample of wire to have the braid removed without injury to the insulation for a distance of about two inches, and the exposed surface held against a flat surface and subjected to the pressure of a hard phosphor bronze edged tool, the sharpness of whose edge shall be that obtained by two surfaces forming an angle of ninety degrees with each other.

"With the tool edge at right angles to the length of the wire, a vertical pressure of eight pounds, applied perpendicular to the flat surface for fifteen minutes, shall not cut through the insulation and complete an electric circuit as indicated by a 16-candlepower 110-volt carbon lamp in series with the tool and wire conductor.

"3. Any rubber compound used as insulation shall be tested for permanent set, elongation and tensile strength as follows:

"New Wire.—A test piece taken from the wire, having insulation less than five-sixty-fourth-inch thick, shall have marks placed two inches apart, and shall be stretched longitudinally at the rate of twelve inches per minute till the marks are five inches apart, and then be immediately released and a measurement taken thirty seconds thereafter, when the distance between the marks must not exceed 2.5 inches. The test piece shall then be stretched until the marks are six inches apart before rupture. The tensile strength shall not be less than 400 pounds per square inch, calculated upon the original cross section of the test piece before stretching.

"Test pieces from wire having insulation five-sixty-fourths-inch thick or over shall be tested in a similar manner, but shall be stretched to four inches instead of five inches, and must not break until stretched five inches, and shall have a tensile strength of 400 pounds per square inch.

Wire tested at any time up to one year from date of manufacture.—A test piece taken from wire having insulation less than five-sixty-fourths-inch thick shall have marks placed two inches apart, and shall be stretched longitudinally at the rate of twelve inches per minute till the marks are four inches apart, and then be immediately released and a measurement taken thirty seconds thereafter, when the distance between the marks must not exceed 2.5 inches.

"Test pieces from wire having insulation five-sixty-fourths inch or over shall be stretched to 3.5 inches instead of four inches.

"Rule 41, Section j.—Add new section 41-j as follows:

"Five chemical tests shall be made of the rubber compound as follows: Acetone extract, alcoholic potash extract, chloroform extract, ash and total sulphur.

"The sum total of the results of these five tests shall not exceed eighty per cent by weight of the total compound—tests to be made according to Underwriters' Laboratories' specifications.

"Rule 45, Section b.—Change to read as follows:

"The insulating covering on each conductor must be of a rubber compound, and must comply with No. 41c, h and j, and must have a thickness of wall not less than that given in the following table:

B. & S. Gage	Thickness Dry Places	Damp Places
18 and 16	1-32	3-64
14	3-64	3-64

"For exception see 45c, 2.

"The electrical tests for No. 14 B. & S. shall be the same as for rubber-covered No. 14 wire, 0-600 volts. The electrical tests for No. 16 B. & S. gage or smaller, and having an insulation thickness one-thirty-second inch or less, shall be as follows:

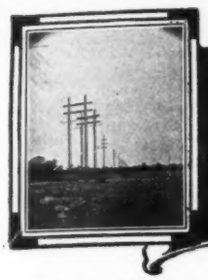
"Every completed single conductor shall be tested by passing it through a spring metal spiral not less than six inches long, so formed as to come in contact with all points on the circumference of the wire, while a voltage of not less than 500 volts for one-sixty-fourth-inch insulation or not less than 1,000 volts for one-thirty-second-inch insulation is applied to the conductor and to the spiral.

"The complete cord shall be subjected to a one-minute test between conductors of 1,000 volts for one-sixty-fourth-inch insulation and 2,000 volts for the one-thirty-second-inch insulation.

"Rule 45, Section d. Add paragraph 5, reading as follows:—

"The completed cord shall be subjected to a one-minute test between conductors of 1,500 volts, and must resist puncture or breakdown when so tested. The source of electromotive force to be the same as that specified in No. 41c."

Tests on fixture wire and flexible cords will be revised later.



CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

ELECTRICITY IN ICE MAKING.

DISCUSSION AT A CHICAGO MEETING OF ITS POSSIBILITIES AS A CENTRAL-STATION LOAD.

A joint meeting of the Chicago Section of the American Institute of Electrical Engineers and of the Electrical Section of the Western Society of Engineers was held on the evening of April 26 at the Western Society's rooms, Monadnock Block, Chicago. A. C. Smith, of the Cataract Power & Conduit Company, Buffalo, N. Y., presented a paper on "Electricity in Ice Making."

Mr. Smith's paper calls attention in a striking manner to the possibilities of electrical supply to ice-making plants as a central-station load. Electric motors have been in use for some time for operating ammonia compressors for refrigeration, but it is only in the last few years that they have been applied to compressors for ice making on a large scale. There have been several difficulties to overcome in applying electric motors for this purpose. It has been contended by the steam advocates that, if distilled-water ice is to be produced, a steam plant is necessary for the distilling and that it might as well furnish the power for the compressors. Where induction motors were proposed to be used, it was difficult to get the desirable variable-speed feature. The first induction motors used for this purpose were provided with pole-changing devices and various sized pulleys which gave several speeds but did not provide close enough adjustment and had a poor power factor. With the wound-rotor type of induction motor a finer speed adjustment is possible and this is necessary, since the compressor must be operated at variable speed to suit changing atmospheric conditions.

A plant in Buffalo using the plate system of ice making was described. Its capacity is 100 tons of ice per day and it has a compressor operated by a 200-horsepower, twenty-five cycle induction motor. An auxiliary thirty-ton compressor is being added for use in winter; it is to be driven by a 100-horsepower motor. City water is filtered and frozen into very clear ice, air being blown through it while freezing. There are also some ten auxiliary motors for various pumps, ice saws, tilting tables and cranes; these aggregate about fifty horsepower. During eleven months of 1910 a total of 16,639 tons of ice were made at a power consumption of 1,445,053 horsepower-hours. The horsepower-hours per ton varied in different months from 57.0 to 116.4, averaging 86.8 for the eleven months. The cost of power per ton of ice was 35.56 cents and with the cost of labor the total cost per ton on the loading platform was 71.56 cents.

In the can system the water is first distilled, therefore it has been customary to use steam-driven machinery. If electric power is to be used, an efficient auxiliary still has to be provided. A 100-ton plant of this type was described by Mr. Smith. It has two eighty-five horsepower boilers for furnishing the steam for the water still. Two forty-five ton vertical compressors are each driven by a 175-horsepower induction motor capable of speed adjustment in thirteen steps. There are also ten auxiliary motors aggregating about fifty-five horsepower. The still has twelve cells and has a total capacity for handling 50,000 gallons of water per twenty-four hours. City water is first passed through a water-softening plant, then through the cells of the still, the first of which takes out all the sediment and scale. In 1910 30,300 tons of ice were produced at a power consumption of 1,772,568 horsepower-hours. The horsepower-hours per ton varied in different months from 49.24 to 89.68, the latter being for a month when abnormal operating conditions prevailed; the average figure was 58.60. The power cost was 23.36 cents per ton and all other items brought the total to 62.10 cents per ton.

The rates for electric power to these plants were made very low on account of the desirable character of the load. They were on a sliding-scale basis varying from $36 to $30 per horsepower-year, depending on the total consumption from month to month, since the power company buys Niagara power and distributes it on a monthly basis. The minimum charge is made so low that the ice company is not penalized for small demand in the winter months. The average load factor for the year of the second of the plants described by Mr. Smith was 89.3 per cent, when figured on the monthly maximum demands, and 65.0 per cent when figured on the annual maximum demand.

Mr. Smith estimates that under the conditions prevailing in Buffalo an electrically-driven distilled-water ice plant, such as he had described, can produce ice at $9 less per 100 tons than a steam-operated plant. The purity of the product of the former would doubtless be higher, because of the complete absence of oil in the condensed steam. For an ice plant using undistilled or raw water, electric power offers the same advantages over steam power that it does in other cases of machine driving. Mr. Smith believes the can system of making ice the ideal one. He also believes that moderate sized electric ice plants will replace the present distributing stations used by natural-ice companies and that this will decrease the storage and haulage to a minimum. For an electric plant variable-speed motors are necessary. It is desirable that more than one compressing unit be provided in order to be able to operate at maximum efficiency just enough machines to meet the season's demand.

The discussion was opened by Chairman G. T. Seely, who stated that the electric operation of ice-making plants seemed to depend on whether the public demand is for raw-water ice or distilled-water ice. In a locality such as Chicago, where there is considerable supply of natural ice from the many nearby lakes, the domestic demand at least seems to be for distilled-water ice.

E. W. Lloyd said the Commonwealth Edison Company, of Chicago, had been investigating electrical supply to ice-making plants and Mr. Smith's paper had borne out some of the conclusions that had been reached, particularly the fact that a ton of ice can be made with an energy consumption of less than fifty kilowatt-hours. Icemaking forms an ideal central-station load. He believed that the Lake Michigan water available in Chicago makes practically as pure a raw-water ice as most of what is supposed to be distilled-water ice. Two electrically operated raw-water ice plants are about to be put in operation in Chicago. Mr. Lloyd thought the rates in Buffalo were excessively low. The Chicago rates for non-peak business (keeping off the heavy peak during the winter months) were sufficiently low to be attractive to such plants; these rates are a primary charge of $15 per kilowatt of maximum demand plus a secondary charge of about four cents per kilowatt-hour. The annual load factor should be the basis of figuring.

W. B. Jackson declared that the very fact that ice making provides a very uniform load throughout the twenty-four hours of the day and, moreover, a load that is much heavier during the summer, when the central station is anxious to develop extra load, should entitle ice-making plants to receive preferential rates.

Homer E. Niesz also dwelt on the desirability of ice making as a central-station load. Although distilled-water ice is apparently demanded for domestic use, the public can probably be educated to use a good but cheaper raw-water ice and thus afford opportunity for electrically operated plants.

Fay Woodmansee expressed the opinion that central stations should

push the installation of small electrically-operated refrigerating plants in residences, apartment houses, hotels, restaurants, etc., as well as larger ice-making plants. He also thought that in many central stations where the boiler-feed water has first to be softened, ice-making plants could well be made auxiliaries to use the exhaust steam from the engines for freezing into distilled-water ice, the ammonia compressors being electrically driven.

W. L. Abbott contended, as the result of some investigations he had made, that the use of the condensed steam from turbine stations would not be desirable for ice plants, as the turbine plant would lose its supply of feed water and also sacrifice considerable of its efficiency. He believed that the economic conditions in large cities required a number of moderate-size electric ice-making plants, located in reasonable nearness to the consumers, instead of one large central plant with its increased cost and loss from haulage.

Prof. P. B. Woodworth stated that numerous analyses in Chicago have shown that raw-water ice could scarcely be detected from distilled-water ice. There should, therefore, be a decided market for the former, which must be made into a clear ice.

Geo. H. Lukes also advocated electric refrigeration for residences, restaurants, ice-cream parlors, hotels, etc. These would not become so numerous as to interfere seriously with the bulk of the domestic demand and, therefore, should not incur the hostility of the larger ice-making plants. At the same time they would form a valuable central-station load.

Mr. Stadenbeck differed with some of the preceding speakers respecting the value of small refrigerating plants. His experience indicated that they prove very troublesome unless they are in the care of a skilled operator.

Frank F. Fowle called attention to the possibilities of electricity in cold-storage warehouses, where refrigerating machinery, pumps and elevators may all be electrically driven and no ice is produced. Small central stations should establish ice-making plants as auxiliaries and bring about the centralization, for the sake of economy, of all the public utilities.

Others who discussed the subject were Messrs. Bird, Jones, Delaney and Pardee. Mr. Smith closed the discussion by stating that several systems for making raw-water ice were being used. The difficulty had been in removing the snowy or discolored appearance from the center of cakes of such ice, which made it unacceptable to many users; this difficulty has been practically overcome by several methods. He thought that, if a central station advocated the installation of small refrigerating plants, it would incur the ill-will of the large ice plants and make it impossible to secure their business, which is much larger than the aggregate of any possible small isolated ice or refrigerating plants. Explaining further the operation of the water still and other features of the plants he had described, he said the initial cost of such a plant was about $1,000 per ton of daily capacity. A valuable adjunct of a distilled-water ice plant is the sale of distilled water.

Philadelphia Electric Pension System.

The Philadelphia Electric Company, which employs about 2,000 persons, has instituted a pension system and has created a fund from which payments are to be made. Every man reaching the age of sixty-five years and every woman at sixty, who has been in the service of the Philadelphia Electric Company during the last ten years, and in future all reaching such ages after fifteen years' service, will be retired and pensioned.

The basis of the pension is to be at the rate of two per cent of the beneficiary's average wages during the highest ten consecutive years of employment, multiplied by the number of years of service. This will also apply to any employee having a continuous and satisfactory service of ten or fifteen years, who has become unfitted for duty.

Telephones for Damp Places.

Special telephones are now issued by the German post office for use in damp places. These telephones are similar to those issued for tropical climates to stand the rainy season. All the iron parts are coppered and varnished, the wooden parts are coated with a waterproof varnish and the remaining parts are covered with impregnated silk.

Copper exports for the week ended April 27 were 4,287 tons.

MUNICIPAL ELECTRIC SERVICE IN GALVESTON, TEXAS.

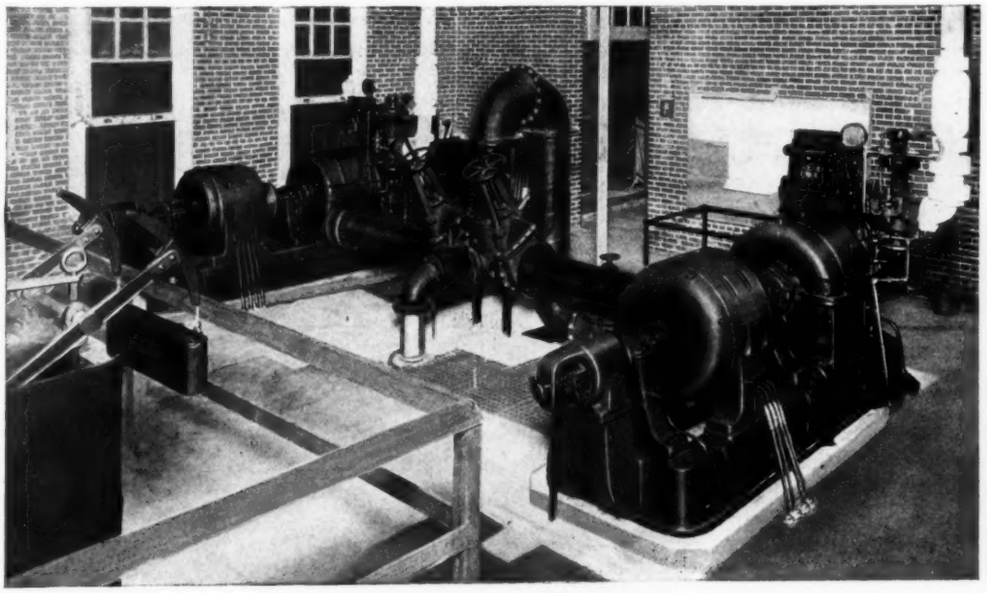
BY M. D. MASTERSON.

The city of Galveston is noted first because of its position as second port in total export valuation in the United States and as the greatest cotton exporting port of the world. Second, because of the awful calamity that visited the city in 1900 and demanded such a heavy toll of life and property. Third, because of the exceptional recuperative energy displayed by her citizens, who, in the face of such a calamity, banded together and by personal taxation built a seawall costing over a million dollars, and afterward raised the grade of the island behind the wall in order to place the city in an absolutely safe condition, secure from a repetition of the 1900 disaster. Further than this, the citizenship is now expending money in conjunction with the railroad interests in constructing a causeway connecting the city with the mainland and affording an elevated entrance-way for the various railroads and the Galveston-Houston Interurban Electric road, and affording also a connecting link between the excellent mainland wagon roads and those of the city. Galveston is also noted as the birthplace of the commission form of municipal government, now so popular throughout the United States. In the electrical field the city has always been progressive. There are two large commercial stations, the Brush Electric Light & Power Company furnishing both power and incandescent service, and the Galveston Electric Company, which furnishes power and incandescent light service in addition to operating the street railway. The city owns and operates its own electric station for lighting its streets and supplying incandescent service to the municipal buildings. The original system selected, which was installed about twenty-two years ago, was the 9.6-ampere open-arc series system. The power station equipment consisted of six Brush arc generators driven by belt connection to two simple engines. This machinery occupied one end of the water-works station and used steam from the same boilers as the pumps. In the spring of 1909 it was decided to run a rough test of the plant to determine if it would pay to

install an entire new system. V. E. Austin, the commissioner of this department, took great interest in the investigation and when my report was submitted he authorized me to immediately advertise for bids for the new equipment. In order to open the field for competition I made no limitation in my specifications as to whether steam turbine or reciprocating engine would be favored. I advertised separately for the new arc-lamp system, including 300 lamps and the necessary transformers, switchboards, etc., and I limited these bids to either the luminous magnetite four-ampere lamps or the metallic flame lamp. The contract was finally awarded to the General Electric Company and the order placed for the lamps. In order to avoid having the city in darkness during the change over, an extra force was put to work on the lines and one circuit cut over each day. Arrangement was made with one of the local power stations to purchase current during the interim.

Specifications governing the generating equipment were, as I have said, very general, and though there was a variance in prices the question of tabulation of bids and awarding of contract was one requiring a great deal of study and careful consideration. There were, after eliminating several incomplete bids, three bids for final consideration. Two were for reciprocating engines and one for steam turbine. In fuel economy, the guarantee of one of the reciprocating engines was much better than either that of the turbine or the other engine, but in first cost this bid was higher than either of the others. However, neither in first cost nor in steam guarantee was there sufficient variance to warrant special consideration. I made my selection more as a matter of suitability and fitness for the service in question. The turbine installation was selected because it contemplated two small units with their consequent flexibility as compared with one large unit of equal capacity; because of the small floor space demanded; because of the establishhed reliability of the turbine and consequent low maintenance cost; and lastly because of the absence of cylinder oil in the exhaust steam which was peculiarly desirable in this installation because jet condensers had been selected, and the condensing water, being taken from the city supply reservoir and returned to the same reservoir, had to be kept as free from impurity as possible.

Since being installed the turbines have fulfilled every promise. The entire fuel consumption of the combined water works and electric light station has been reduced thirty-five per cent, which, when considered with the comparative consumption of the two departments, represents a saving of about sixty-five per cent in fuel cost of the electric light department, due to the combined influence of the luminous ares and the steam turbines. The yearly expense of the electric light department was cut down from $25,000 previous to the new installation, to $18,000 subsequent to the new installation. The acceptance test on the turbines showed close to twenty-eight pounds of steam per kilowatt-hour measured at the switchboard, and the lamps came within their rating of 300 watts per lamp, which figure, however, is of course dependent on the exact length of arc for which the electrodes are adjusted. We trim the lamps every 200 hours, since experience has shown that the factory gaurantee of 170 hours is very conservative. We have had no trouble whatever with the turbine installation since it was first set in motion. We use steam pressure of 125 pounds at the throttle after it has passed through a separator. The turbines exhaust into a 28-inch vacuum maintained by a jet condenser working in conjunction with a rotary vacuum pump. The generators, direct-connected to the turbines, are two-phase, 2,300-volt, 60-cycle, excited by direct-current generators mounted on the end of the same subbase and also direct-connected to the main shaft of the turbine driven at 3,600 revolutions per minute. There are two generator panels with instruments, switches, etc., and one synchronoscope with necessary lamps and plugs. There are six 50-light arc-circuit panels, six tub transformers and mercury-arc rectifiers. E. J. Owin is chief engineer at the station.



MUNICIPAL PLANT IN GALVESTON.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

ELECTRIC STREET LIGHTING.—VI.

BY ALBERT SCHEIBLE.

LIGHT DISTRIBUTION FOR DIFFERENT CLASSES OF STREET LIGHTING.

In the early days of street lighting hardly any attempt was made to distinguish between variations in the requirements of different cities or even of different sections of the same city. Sometimes the lamps were spaced more closely in the business sections—say at every corner intead of on alternate corners—but usually the same lamps and the same placing of them was adopted for all streets. If the density of foliage on some streets required the lamps there to be hung low, the same height was too often adopted for the unshaded streets also, although an increased height was known to be more effective. Too often compromises were made for the sake of uniformity, giving few or no sections of the town what was best adapted to their needs.

Even today this question of giving every part of a city what is most suited to its requirements is rarely handled with the same breadth as are other municipal problems, for in other lines there is a continual aim to adapt the means to the particular needs of each section, making due allowances for gradual changes in different localities. The underlying motive in the planning of street lighting has too often been that of securing the biggest impression of light for the money, rather than that of distributing the light thus obtainable to the best effect. It is the means—the dazzling lamps—rather than the objects of street lighting that have too commonly been prominent.

Neither have the changes involved in adopting other types of lamps under new street-lighting contracts always been made with a careful study of the local conditions, nor is there usually any provision for readjusting the lighting to meet the changing conditions of foliage, buildings and traffic. Where cities are rapidly growing and developing, a really advantageous use of the street lamps would imply their being redistributed and rearranged every few years, but in actual practice the lamps when once up are generally left where they are and only the new additions are considered. Even for placing these the methods of procedure are rarely such as would be countenanced in any high-grade business venture, being too often about as reported some time ago from Worcester, Mass.[1]

Some towns have even gone further than to let the all-wise city fathers decide the street-lighting problems. They have put them before the people as a whole by giving comparative demonstrations of different methods of street lighting in adjoining blocks. Whether this mode of passing upon public improvements will have to be extended into other lines to show more fully the questionable, if not foolish, results obtained by it, is not yet clear. The problem of economical and effective street lighting certainly is one worthy of being passed upon by experts, rather than by an impressionable public.

FIG. 1.—HIGH STREET-LAMP SUSPENSION.

On the other hand, the last few years have brought decided progress towards securing a logical use of electric units for different conditions in the perfecting of tungsten lamps as well as modern types of arc lamps for use on one and the same circuit. In

1 All petitions for new street lights go to the committee on street lighting and that committee, accompanied by the superintendent of streets, makes a trip to every location where new light is petitioned for.

The members stand off at various distances from the nearest street light and try to read watches, printed matter and do other stunts that may prove to their minds the need of a street light, and then they go back to City Hall and vote for the lights that lie in the district of the member of the committee with the biggest pull.

One member of the committee told a *Post* reporter that he has found certain localities where street lights have been petitioned for, pruned for the committee. Not a light shone out of a single window in the house in front of the location and there wasn't anything within a radius of a quarter of a mile that would help to light any portion of the street.

He investigated and found that an order for the same light had been introduced the previous year and rejected. He learned that on the night the committee on street lighting went out to take a view, the house in front of which the light was petitioned for was brilliantly lighted up and the light was reflected into the street strong enough to completely satisfy the committee there was no need of a light. The committee rejected the petition. On the second trip of the committee, no lights shone out from the house and the need of a light became more apparent. The committee recommended a light.

most of our larger cities the street lighting would be improved if it were furnished by units graduated according to the requirements and conditions in different parts of the town. As W. D'A. Ryan well said a year ago:[2]

"In general, it is good practice to use large units to light the principal streets of a city. A large volume of light reflected from the buildings is quite as important in giving the city the appearance of being well illuminated as the amount of light projected directly on the street surface. Large units should be placed thirty to fifty feet high and intermediate size units twenty-five to thirty feet high when possible. Where it is the practice (in the suburbs particularly) to space arcs at long intervals, it is impossible to obtain good results. In such cases it would be much more satisfactory to use small units (such as tungsten lamps) at shorter intervals, particularly where the buildings are considerably removed from the sidewalk line and do not assist in the general effect by reflection. * * * We now have available three high-efficiency units which can be operated in series on the same circuit: the 6.6-ampere luminous arc (metallic-flame arc) for lighting the principal streets; the 6.6-ampere flaming arc lamp (impregnated-carbon arc) for lighting parks, squares and other open places; and the 6.6-ampere tungsten units for residential and incidental lighting."

In thus planning to cover a large city with only a three-fold variety of lamps, Mr. Ryan seems to have overlooked two important factors, one being the display element which is demanded on many business streets and of which more will be said later. The other is the influence of the light reflected from the buildings in giving the street the appearance of being well lighted. Allowance for these factors makes either the pure carbon or the luminous (metallic flame) arc lamps, with the low height at which both are effective, insufficient for the more important business streets. The latter will require either tungsten lamp-posts (if a display effect is the essential) or impregnated-carbon (flaming) arcs hung thirty to fifty feet high if the building fronts are to be well lighted.

In raising high candle units to such a height above the ground, Americans have followed their old custom of using posts at street corners, or occasionally extended trolley poles in the centers of the streets. Europeans, on the other hand, have adopted the American methods of cross-suspension, using houses on opposite sides of the street as supports. The accompanying illustrations of streets at Hamburg and Cassel show how well these elevated center suspended lamps utilize the reflecting power of the buildings, adding greatly to the appearance of a street.

(To be continued.)

FIG. 2.—STREET LIGHTING WITH HIGH CENTER-SUSPENDED LAMPS.

FIG. 1.—LADDER MOUNTED ON EXPRESS WAGON.

The Electric Vehicle as Applied to the Trimming and Inspection of Arc Lamps.

The trimming of the lamps on the newly erected twin lamp poles in the central section of the city of Philadelphia proved to be quite a problem. As a temporary makeshift, a twenty-four-foot, two-section ladder was set on a quadrant, placed in the body of an ordinary express wagon (Fig. 1) and so arranged that the ladder could be swung to either side or made to assume an upright position. This arrangement answered the purpose, but the expense of operation was too great, as it necessitated the services of a horse and driver in addition to the trimmer.

The design and construction of an electric tower wagon was then considered, but the main difficulty was to devise a plan to obviate the necessity of having an extra man to do the trimming, as otherwise the driver would be compelled to climb to the top of the tower to trim each pair of lamps. At the suggestion of A. H. Manwaring, engineer of arc lighting of the Philadelphia Electric Company, an electric tower wagon was designed that could be operated from either the upper platform or the driver's ordinary position at the floor level, and equipped with a turn-table at the top to enable the operator to trim the lamps on both the street and house sides of the poles. The Commercial Truck Company, of Philadelphia, collaborated with Mr. Manwaring. Figs. 2 and 3 show the result.

2 Paper before the National Electric Light Association on "Luminous and Flame Arcs vs. Open and Inclosed Carbon Arcs for Street Illumination."

The tower wagon is constructed on the ordinary 500-pound chassis, the weight of which without the tower and including the battery, is 2,600 pounds. The weight of the tower is 650 pounds, making a total weight of 3,250 pounds. The vehicle is equipped with a forty-two-cell, seven-plate Philadelphia storage battery, which will furnish an average speed of fifteen miles per hour on the level, and has a mileage capacity of thirty miles per charge. The wheels are equipped with 2.5 by 36-inch Firestone tires, both front and rear. The controller is mounted on the upper platform, and can be operated from either the upper or lower seat by a tube outside the steering shaft. The reversing mechanism is a Z-slot bushing keyed on the controller tube,

FIG. 2.—ELECTRIC TOWER WAGON.

which is worked from the upper seat by the foot and from the lower seat by the hand. The steering gear is mounted in the usual manner and is worked from the upper or lower seat by a shaft which runs through the controller. The brakes can be worked from the lower seat by a foot lever in the usual manner, and from the upper seat by a foot lever rod and bell crank. The upper foot lever has an extension, so that the operator can set the brakes from the top seat, climb down and release the brakes from the lower seat, or vice versa. The electric bell is operated from either the upper or lower seat by a floor push in the toe-board. The platform is thirteen feet six inches from the ground, and an additional height can be secured by hanging a portable stand from the side rails, which will increase the height to either fourteen feet or fifteen feet six inches, depending on which rail is used.

A test of the stability of the machine was made by suspending a weight of 700 pounds from the end of the platform when turned in the position occupied by the trimmer in trimming the lamps (Fig. 3). This test was made before the battery was installed and proved the stability of the tower wagon under the most severe working conditions.

The tower wagon has been giving very satisfactory service, and enables the trimmer to cover each of his routes in approximately six hours, while by the old method nine hours were required to accomplish the same results.

Formerly the inspection of these lamps necessitated the stationing of a horse-drawn wagon and driver at a centrally located point, and also the use of a motor-cycle, the operator of which covered the district lighted by the ornamental lamps in about four hours. He reported all faulty lamps to the driver, who would proceed to the various locations with the team and start or change the defective lamps.

The tower wagon eliminated the necessity for the horse-drawn wagon and motor-cycle, as by its use all the lamps on ornamental poles are inspected in approximately two and one-half hours, and faulty lamps started or changed by the operator, who carries a number of lamps for this purpose on the tower wagon.

This new method of trimming and inspecting the ornamental lamps shows a daily saving in the cost of transportation and labor of approximately thirty-three and one-third per cent over the former method of using the horse-drawn wagon and motor-cycle, and in addition to this the tower wagon has a decided advertising value, as it attracts a great deal of attention on the streets. On one side of the body has been painted "Use Electric Light" and on the other side "Use Electric Power."

Energy Necessary for Vision.

The energy necessary to produce the sensation of light is less than 8×10^{-7} erg, according to William Duane, in the *American Journal of Science* for April. This figure is based upon the phosphorescence produced in zinc sulphide by the alpha rays from radium. Since this energy is radiated in all directions, only a small fraction of it enters the eye.

Lighting Rates in Toledo.

The City Council of Toledo, O., has passed an ordinance fixing the rates to be charged in Toledo for electric lighting during the next five years. Despite a notice from the Toledo Railways & Light Company that it would not accept the rate, the ordinance was passed fixing the maximum residence electrical lighting rate at eight cents per kilowatt-hour with a discount of one cent if payment is made within ten days, which amounts to a seven cent rate net. The new ordinance also reduces the monthly minimum charge from $1.00 to fifty cents. The rate under which the company has been operating is nine cents with a ten-per-cent discount for cash, and a monthly minimum charge of one dollar.

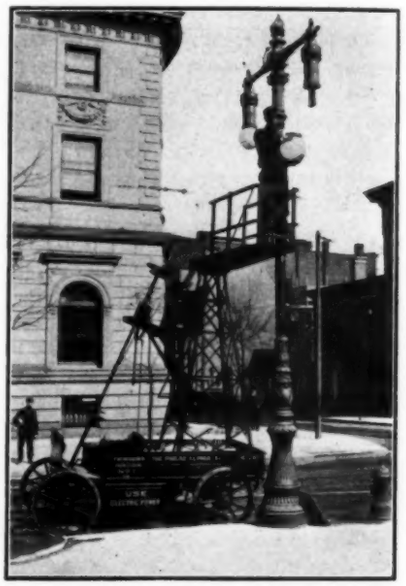


FIG. 3.—TRIMMING A LAMP.

Police Signal Lights Approved in Buffalo.

A system of electric signal lights has been installed on the police boxes of the third police precinct in Buffalo, N. Y. Each box has a red and a green light, also an electric bell, under the control of the central operator for calling any patrolman while on duty. The system has met with such favor among the police authorities that it is proposed to extend it, in a short time, to all sections of the city.

TELEPHONY—TELEGRAPHY, and WIRELESS.

TELEPHONE-RECEIVER EFFICIENCY.

BY GREENLEAF W. PICKARD.

Although the telephone receiver has been the subject of numerous investigations, less is known about its quantitative relations of energy intake and output than in any other important electromagnetic mechanism. The prior measurements of its efficiency do not even agree with respect to the order of magnitude of this quantity, ranging all the way from 0.05 per cent to 10.0 per cent.

A telephone receiver is, of course, simply an electric motor, converting the energy of the electric current into motion. Were it not for the peculiar form taken by the motion, it would be possible to measure directly the efficiency by metering the electrical power intake, and determining the mechanical energy by some form of absorption dynamometer, small as these quantities actually are. But motion in the form of to and fro diaphragm vibration is not readily measured, particularly when the amplitude is of the order of a few millionths of a millimeter.

In any of the ordinary bridge measurements of inductance by comparison with a standard inductance, it is necessary to balance not only the inductance, but the resistance as well. The measurement gives, therefore, not only the inductance of the winding under test, but also its apparent, or effective resistance. If a telephone receiver is thus measured, using any desired frequency of alternating current to energize the bridge, the effective resistance thus determined is simply the sum of all the dissipative resistance or losses in the receiver, including the alternating-current resistance of the winding, the eddy-current losses in the pole-pieces and diaphragm, the energy transformed into diaphragm vibration, the hysteresis loss in the various iron and steel portions of the magnetic circuit and probably several other and minor losses, such as dielectric hysteresis, etc. Obviously, if the diaphragm were so held that it could not vibrate, that part of the effective resistance due to this vibration would vanish, and if the other losses remained constant it could readily be determined.

The writer has employed this method of determining receiver efficiency for some time past, and has even extended it to the study of allied electromagnetic mechanism. It does not appear to involve any questionable assumptions, and is readily carried out with very simple apparatus. The accuracy obtainable is of the same order as in ordinary efficiency measurements of motors and generators.

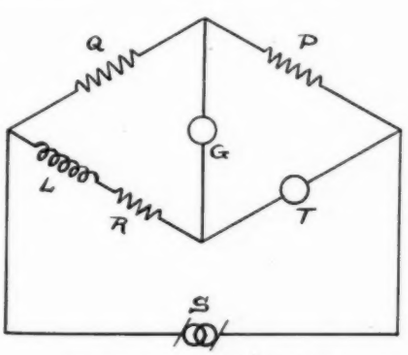


DIAGRAM OF CONNECTIONS.

The circuit employed by the writer is shown in the diagram herewith.

Q and P are two equal resistances, of about 100 ohms. L is a variable inductance, of sufficient range to include the inductance of the instrument under test, and R is a variable resistance. A telephone receiver G is used in place of the ordinary bridge galvanometer, and alternating current from a suitable source S energizes the bridge network. The telephone receiver to be measured, T, is balanced against L and R. If the current supply is truly sinusoidal, an extremely sharp balance, indicated by practically no sound in G, is obtained by the adjustment of L and R.

This measurement is first made with the receiver T in normal condition, with the diaphragm vibrating freely, and then repeated with the diaphragm immobilized. Two values are thus obtained for the effective resistance, one including the dissipation of energy from the vibrating diaphragm, and the other exclusive of this source of loss. The difference between these two effective resistances, divided by the larger resistance, is the efficiency of the receiver.

In immobilizing the receiver diaphragm, it is important that no change be made in any of the other electrical constants of the receiver. The writer found that stiff vaseline, filled in the space between the diaphragm and the ear-piece, and also between the pole-pieces and the diaphragm, served the purpose excellently, being sufficiently fluid to allow the diaphragm to take its normal position, and at the same time being quite rigid against its rapid vibration.

As an example of the method, the measurement of a thirty-ohm telephone receiver is tabulated below.

Steady current resistance	31.74	ohms.
Inductance at 500 cycles, diaphragm free	21.0	millihenrys.
Effective resistance, diaphragm free	71.2	ohms.
Inductance, diaphragm immobilized	20.6	millihenrys.
Effective resistance, diaphragm immobilized	67.6	ohms.
Difference	3.6	ohms.
Efficiency	5.06	per cent.

As the efficiency varies with the frequency of the alternating current used, a complete study of a telephone receiver would of course involve similar measurements with a number of different frequencies, so chosen as to fairly represent the range of telephonic frequencies.

Medical Advice by Wireless.

The captain of a vessel sailing in the Gulf of Mexico was taken suddenly ill, and, being without medical assistance, the wireless operator sent a message for assistance. It was responded to by a vessel 1,000 miles off, and advice given.

Telephony on Moving Trains.

A demonstration of wireless inductive telephony to and from moving trains was given by H. von Kramer and Railophones, Limited, at Stratford-on-Avon, England, on April 20. A representative of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN was present, together with railway experts, engineers and newspaper representatives. Miss Marie Corelli, the famous novelist, spoke the inaugural message. A ten-mile section of the Stratford-on-Avon and Midland Junction Railway Company has been equipped for showing the possibilities of the system. On account of the fact that the patents covering the system have not yet been taken out in all countries, the inventor has not given out complete technical details, but the principles upon which the system is worked may be stated.

Speech or signals are transmitted by electromagnetic induction between a large coil of wire on the railway coach, and a stationary wire buried along the track. Thus, current variations in either the train coil or the stationary track circuit, due to either telephonic currents or signaling impulses, will produce a varying magnetic field which, as it is linked with the other circuit, will induce currents in it and operate the recever. Thus the coil on the train and the buried wire on the track may be looked upon as the two coils of an ordinary telephonic transformer, with the difference that they are separated, one being on the train and the other along the track.

On the experimental track at Stratford-on-Avon, the wire in the railway stations and at crossings is buried in the railway embankment on one side of the track, and consists of a bare iron wire placed in a wooden trough filled with bitumen, but upon the open lines it is suspended on short wooden poles, one foot high, close to the track. This wire is joined up with the rails, which form the return wire, and thus completes the circuit with the telephone instruments in the signal box or other desired position. One coach of the train is fitted with two large coils of insulated wire, hung horizontally from the bottom of the coach. One of these is connected with a telephone transmitter, and the other with a receiver. It is understood that the transmitter used both on the train and in the signal box differs only from the ordinary pattern in general use, in having a somewhat lower resistance. The current employed in transmitting is said to be about three amperes, in order that a sufficiently strong magnetic field may be produced. The receivers are of the ordinary pattern.

The telephone box on the train is mounted and padded, with the view of avoiding interference from the noise of the train, and of course, apart from passengers being able to transmit ordinary commercial messages whilst the train is in motion, there are great possibilities in the system in connection with the prevention of accidents. As there are two coils on the coach, one for receiving and one for transmitting, the operator speaks and listens as with an ordinary telephone. In the case of the stationary telephone box, however, it is necessary at present to switch over from the transmitter to the receiver when it is desired to receive a message, as the receiver will not carry the heavy current required for transmitting.

The chief difficulty in developing the system has been the elimination of disturbances, due to the ordinary telegraph wires along the railway track. Originally the coils on the train were arranged vertically and in a longitudinal plane, the lower side of the coil only being active, while the remaining part extended over the roof, and was inclosed in a tube of brass or other non-magnetic metal. This method, however, has been abandoned, and the difficulties are now overcome by a special method of winding the coils.

An important development of the system foreshadowed by the inventor consists in tuning the signals to and from different trains, so that a train will only pick up the impulses to which its apparatus is tuned. Experiments are also being conducted with a relay which will automatically switch over from the transmitter to the receiver, and *vice versa*, in the stationary telephone box.

The system is to be installed on the London, Brighton & South Coast Railway, over a distance of thirty miles in the middle of the route between London and Brighton, and the express train known as the "Southern Belle" will be equipped with the necessary apparatus, thus enabling passengers to send or receive messages during the journey from London to Brighton

Telephones on the Pennsylvania Railroad.

The use of the telegraph has been entirely done away with in the way-station towers of the Middle Division of the Pennsylvania Lines East, which extends from Harrisburg to Altoona. The only telegraph business here consists of through messages between division points.

Telephone equipment is now in successful operation also over the Philadelphia Division, from Philadelphia to Harrisburg. These two form what is known as the Grand Eastern Division. On the two sections named the telephone is now being used for dispatching, message and blocking work.

Between Harrisburg and Philadelphia a system of sending out time on the telephone wires has recently been put into effect. The system in use is one developed by the Western Electric Company, which has supplied the telephone equipment of these two divisions. It consists essentially of the installation at each way station of 1,000-ohm ringers in series with the selector, and at the dispatcher's office a transformer is arranged so that the telegraph relay which receives the time, makes and breaks the primary. This causes alternating kicks to be generated in the secondary, which operates all the time bells, reproducing the taps which were formerly heard on the telegraph sounder.

The Pennsylvania Railroad has adopted for use in block towers interrupters for signaling on all the radiating lines which require code ringing. These interrupters are operated by push buttons, which close the local battery and send alternating current on the lines. This railroad was the first to use this type of interrupter and has found that by its use the operators save both time and energy in ringing on the lines.

At Harrisburg the telephone business of the Pennsylvania Railroad is handled through a central-battery multiple switchboard of the newest type, with four positions, and connected with the lines of the Bell Telephone Company of Pennsylvania. Extensions reach all the offices and departments in the big station at Harrisburg and the residences in that city of many of the officials and employees. Trunk lines from this board go to Altoona and Philadelphia and to small switchboards

located at important points both east and west on the railway's telephone system. A unique use of this service is made in the train shed at Harrisburg, where an usher announces trains when notified over the telephone by the station master.

Altoona, which is a busy railroad city, also uses a multiple-exchange equipment of the type used in large operating offices. The fact that over 4,000 trunk calls were recorded every twenty-four hours recently led to an order for the equipment of additional trunk facilities for this exchange. The telephone is used in this city for calling employees to duty. This is a task which formerly occasioned the employment of many messenger boys. Today each railroad man has a telephone in his home connected to the central exchange in the railroad office.

The station at Harrisburg as well as the one at Altoona is equipped with a toll test board, the use of which permits quick and accurate tests over both telephone and telegraph circuits of the railway's dispatching and message system.

Each way station is equipped with a special switchboard of the Pennsylvania Railroad Company's own design. This board contains ten combined jacks and signals, which are equipped with local contacts for code ringing. Two telephone sets are placed in each way-station tower, one mounted on a special transmitter arm, the other an emergency desk-stand telephone with head receiver.

The Telephone in Emergency and Wreck Service.

The Delaware, Lackawanna & Western Railroad has in service the portable test sets for the use of its linemen, with the extension pole, whereby telephonic communication may be secured at any point on the line. Two recent incidents well illustrate the value of the emergency service of the telephone. The experience in this line is that the time saved by the telephone as compared with the telegraph in clearing wrecks is considerable and is appreciated, although it may be difficult to state it in figures.

One afternoon recently one of the linemen was riding on a freight train on the mountain section, about a mile and a half west of a station, when a truck under one of the cars broke, and the momentum of the train scattered six cars, blocking two of the three tracks. An east-bound fast passenger train was nearly due and several manifest trains were about to take the slow track which all along remained open.

The lineman immediately notified the dispatcher with his portable set, with the result that the manifests were detained long enough to detour the fast passenger train, and the slow track was held open until the wrecker had got alongside the spill and cleared one of the fast tracks. The superintendent estimated that the lineman's prompt action and the control of the situation by telephone had saved sixty per cent of the time required to clear the track if traffic had been permitted to congest.

In another instance an engine broke a main rod at a point three miles from the nearest station. With the portable telephone set the dispatcher was communicated with, who provided an engine from a freight train laid up at the first station ahead. If the portable telephone set had not been available on the train, the time lost would have been equivalent to that consumed in walking three miles.

With the portable telephone sets in the hands of men on the trains, the dispatcher, in the event of an accident, is enabled to talk with the man who knows all the facts in the case. Even if the man on the ground, by reason of the excitement incident to the emergency overlooks some details or assigns to them minor importance, the dispatcher, having the greater experience may, by his questions, elicit in conversation over the line, a detailed account of the situation which will serve as a basis for his action.

A Long Telegraph Circuit.

What was probably the longest direct telegraphic circuit yet used was established for the use of a Mexican war correspondent stationed at Douglas, Ariz. Messages were transmitted to New York by way of Los Angeles, El Paso, Dallas, Kansas City, and Chicago. This route was chosen as the most easily available and the line was held in service for over an hour. The direct distance between El Paso and New York is about 3,800 miles.

The next convention of The National Irrigation Congress will be held in December at Chicago, Ill.

Semi-Automatic Telephone Exchange in Australia.

The city of Amsterdam in Holland formerly had but one telephone exchange. Another exchange was opened on May 1 to provide for the increasing traffic. The telephone authorities were impressed with many features of the automatic system, but were reluctant about adopting the full automatic equipment. They therefore decided to install the semi-automatic system in the new exchange. Upon its success will depend its extension to the old exchange.

A New Source of Rubber.

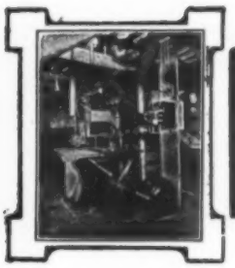
Representatives of the American-Mexican syndicate that is preparing to manufacture rubber from the palo amarillo tree on an extensive scale have been busy for several months contracting with land owners for the rights to use these trees and it is stated that several million acres are now under control of the syndicate. Among the men interested in the big project are David E. Thompson of Lincoln, Neb., former United States Ambassador to Mexico; Lieutenant Colonel Porfirio Diaz, son of President Diaz, and Colonel Felix Diaz, nephew of the president of the republic. Experiments in the manufacture of rubber from the palo amarillo tree have been in progress for some time, and they are said to have given results entirely satisfactory.

The first of the rubber manufacturing plants of this syndicate is in operation at Empalme Gonzalez, State of Guanajuato, and the machinery has arrived in this country from the United States for five other plants, which will be installed in this state and in the neighboring State of Jalisco.

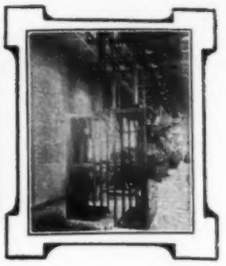
Wireless for Aeroplanes.

Experiments are being carried out at College Park, Washington, on the transmission of wireless messages from aeroplanes. It was in this place that the first tests of this kind were carried out. Efforts will be made to have a number of officers trained in aviation and experiments will be made in sending wireless messages to the War Department laboratory in Washington, the Navy Yard and the wireless station at Annapolis.

This work is being carried on by the officers of the Signal Corps, United States Army.



Industrial Power



ELECTRIC DRIVE IN A LEAD SMELTER.

BY J. E. BULLARD.

When the Webb City Smelter & Manufacturing Company decided to erect a 500-ton lead smelter at Webb City, Mo., it thoroughly investigated the power question from every point of view. It could buy a high-grade natural gas at 12.5 cents per thousand feet for boiler firing, and at 25 cents per thousand feet for gas-engine fuel. This meant that power from a steam or from a gas-engine plant would be very cheap. However, if either of these powers were used it would be necessary to drive long lines of shafting, install several small, troublesome and rather inefficient units, or lay out the plant inefficiently from a production point of view. After several months of investigating, deliberating and planning it was finally decided to use electric-motor drive throughout and to buy the electricity from the Empire District Electric Company.

The site of the smelter is in the heart of the heaviest lead-producing camp of the Southwest Missouri mining district. The ore comes to the smelter from the nearby mines and is hauled either by teams or by rail. The arrangement of the buildings is shown in the accompanying photograph. The ore is weighed on the scales at the office and all but the very coarse is shoveled directly into the ore room. The very coarse is shoveled into the crusher house where it is crushed and conveyed by means of a bucket elevator to the ore room. Throughout the entire length of the ore room and the jumbo room extends a trolley. On this trolley travels a hopper in which the ore is conveyed to the jumbo furnaces. At these furnaces the greater part of the lead is recovered. The lead from the furnaces is carried to the refining room on trucks. There it is refined, cast into pigs, weighed and loaded into freight cars. The smoke from the jumbo furnaces is sucked up into a large pipe which ends in the goose neck tower. The goose necks empty the smoke into the bag room. In the course of the long travel through the goose necks and the bag room practically all of the lead dust settles to the bottom. It is then raked out through doors for that purpose and wheeled back in barrows to the cupola furnaces. In these furnaces the lead is removed from the dust and then goes to the refining room to be refined and loaded into the cars. The ore travels the shortest possible distance between each operation and always practically in a straight line. The use of electric motive power not only made this possible but materially reduced the size of the buildings which would have been necessary had any other form of power been utilized.

LEAD SMELTER AT WEBB CITY.

If we pass along the path taken by the ore we find the motors arranged as follows. The first motor is the fifteen-horsepower one used to drive the crusher and elevator in the crusher house. In this building there is bound to be a good deal of dust. The motor, therefore, has been completely inclosed in a wooden box in the upper northwest corner of the building. This motor has a ten-inch by six-and-one-half-inch pulley and is belted to a short countershaft on the other side of the building. The crusher and the elevator are each belted to this countershaft. Since it is necessary to operate all the machinery in this building whenever any part of it is operated this method of drive proves more satisfactory than individual drive. The next motor is connected to the blower furnishing the forced draft to the jumbo furnaces. This motor is located in a little room in the southwest upper corner of the ore room. The motor room is just large enough to contain the motor, blower and belts and is placed close to the roof so it does not interfere materially with the storage of ore. This motor is of twenty-horsepower size and is connected by means of a flexible coupling to a short countershaft on which are mounted two twenty-six inch by five-inch pulleys belted to either side of a forty-five-inch Buffalo blower. Next come two motors shown in opposite photograph. These are located in the motor room south of the goose necks. Both of these motors are twenty-five horsepower and have ten-inch by ten-inch pulleys. The farther one is belted to a Buffalo Forge Blower Company exhaust fan used to keep up a circulation in the goose necks. The nearer one is belted to a Wilbraham-Green blower which supplies the forced draft to the cupola furnaces. The elevator is driven by a fifteen-horsepower motor. The deep-well is geared to a ten-horsepower motor. As a large quantity of water is circulated around the cupola furnaces while they are in use and as this water must be fairly cool a pond has been constructed

to collect the water which has been used, allow it to cool and let the dirt settle. It is then pumped back by a circulating pump to which is direct-connected a 7.5-horsepower motor.

All these motors are three-phase, twenty-five-cycle, 220-volt machines. All of them with the exception of the circulating-pump motor operate at 750 revolutions per minute. The circulating-pump motor operates at 1,500 revolutions per minute. All the current is delivered to the consumer and metered at 2,300 volts. In the transformer house are located three forty-kilowatt transformers and one 7.5 kilowatt transformer. Here also is a two panel switchboard on which are mounted the wattmeters and circuit-breakers, and the switches controlling the different motor and light circuits.

When the metal market is strong the smelter operates twenty-four hours a day, which means a very high load factor. The motors on the blowers and exhaust fans are then running continuously at full load. The elevator is constantly used to charge the cupola furnaces and the pump motors are run the greater part of the time. The only one which is not running almost continuously is the crusher-house motor. The load factor on this motor is likely to be comparatively low.

TWENTY-FIVE-HORSEPOWER MOTORS BELTED TO BLOWERS.

The power system of the Empire District Electric Company is supplied mainly from a 20,000-horsepower steam-turbine plant located about eighteen miles west of the smelter. The current is transmitted through the district over a 33,000-volt line forming a complete belt. The smelter is about midway between two substations which receive the 33,000-volt current and step it down to 2,300 volts. It is now connected to the substation at which is installed a 2,000-horsepower gas-engine generating plant used as an emergency plant, and will soon be tied in with the other substation.

This ring system of connecting up the consumers so that they may be supplied from either of two directions is proving extremely satisfactory to all the power users. It makes possible very uniform and continuous service and serves as an effective insurance against shutdowns. This fact is often the deciding factor when a power prospect is contemplating the use of electric power and had a great deal of weight in the decision of the Smelting Company to use the electric power sold by the Empire District Electric Company.

Electricity on Ontario Farms.

In a recent consular report of the progress of agriculture in Ontario, Canada, Consul F. S. S. Johnson, of Kingston, says that as to the future development of agriculture in Ontario, the prospect for the adoption of electricity for some of the farm work should be taken into consideration. The hydro-electric power commission, which is now working out to success its plans for supplying power to towns and cities, has been awarded contracts for the erection of a transformer station in connection with the agricultural college at Guelph, in order that this institution may have the benefit of hydro-electric power, which is expected to conduce to both efficiency and economy; but still more important are the plans of the commission for placing cheap power at the disposal of the individual farms in the electric zone.

It is too soon to say how far electricity may be economically and successfully applied to the problems of the Ontario farm, but the extent to which invention has already revolutionized rural life gives a basis for the most enthusiastic expectations.

Floating Dock at Montreal.

Electric power will enter very extensively into the equipment of the new naval works which are to be constructed in Montreal on behalf of the Harbor Commissioners. The scheme is a very ambitious one. It includes a floating dock large enough to take merchant and war ships of a displacement of 27,000 tons, a basin for accommodating ships being fitted out or repaired, and extensive workshops. The floating dock is to be built at once and will, it is expected, be ready next season for the accommodation of the largest of the ships sailing up the St. Lawrence. The site of the works occupies some thirty acres, and for nearly a year the Harbor Commissioners have had extensive excavating operations in progress for its preparation, six large dredgers and various land-excavating machines having been continuously at work. Building operations and the construction of the masonry walls will soon begin.—*The Electrical Engineer.*

Growth of Electric Vehicle Industry in the United States.

In a bulletin issued by the United States Bureau of Census on the automobile industry there are given some interesting statistics on the numbers and values of the different classes of automobiles in use in 1909, compared with the corresponding figures for 1904. In the former year the number of electric vehicles in use in the United States was found to be 1,425 and their value was $2,496,300. In 1909 the number of electrics was 3,639 and their value $6,564,500. The increase in number of machines in the five years was 155 per cent and in value 163 per cent.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

NORTHERN OHIO TRACTION & LIGHT.

The report of the Northern Ohio Traction & Light Company for the month of March and three months ended March 31, compares as follows:

	1911.	1910.
March gross	$190,186	$173,424
Expenses and taxes	110,850	99,159
March net	79,336	74,265
Charges	44,329	43,291
March surplus	35,007	30,974
Three months gross	548,871	484,575
Expenses and taxes	322,622	286,173
Three months net	226,248	198,403
Charges	133,115	129,875
Three months surplus	93,133	68,528

NASHVILLE RAILWAY & LIGHT.

The report of the Nashville Railway & Light Company for the month of March and three months ended March 31, 1911, compares as follows:

	1911.	1910.
March gross	$156,961	$149,276
Expenses and taxes	95,379	87,720
March net	65,582	61,556
Charges and depreciation	38,079	38,168
March surplus	23,503	23,389
Three months gross	470,146	434,314
Expenses and taxes	277,896	248,298
Three months net	192,251	186,016
Charges and depreciation	114,261	114,100
Three months surplus	77,989	71,916

UNITED RAILWAYS OF ST. LOUIS.

The report of the United Railways of St. Louis for the month of March and three months ended March 31, 1911, compares as follows:

	1911.	1910.
March gross	$ 982,271	$ 972,494
Expenses, taxes and depreciation	692,497	705,876
March net	289,774	266,617
Other income	3,471	3,679
Total income	293,245	270,297
Charges	229,545	233,708
March surplus	63,700	36,589
Three months gross	2,767,180	2,658,769
Expenses, taxes and depreciation	1,934,308	1,921,184
Three months net	832,871	737,584
Other income	10,890	10,626
Total income	843,761	748,210
Charges	691,794	700,446
Three months surplus	151,967	47,764

NEW YORK TRACTION EARNINGS.

The New York Public Service Commission has issued the following statement showing the earnings of the principal New York Traction lines for the month of December, as follows:

	Total St. Ry. Oper. Rev.	Net Rev. from Oper.	Total Income	‡Surplus after chargs.
Hudson & Manhattan	$ 261,858	$134,530	$ 204,967	$ 11,667
Interborough:				
Subway	1,381,492	748,922		
Elevated	1,378,896	640,344		
			1,416,587	527,135
Brooklyn Rapid Transit	1,804,036	576,586	610,043	81,678
†Metropolitan Street Railway	1,116,919	267,741	283,238	64,050
Central Park, N. E.	50,179	*2,322	*2,230	*3,170
†Second Avenue	64,014	*7,521	*4,271	*17,992
†Third Avenue	291,416	122,208	128,217	94,096
†Dry Dock	49,711	7,135	7,628	*1,190
†Forty-second Street, Manhattan	113,207	29,890	33,670	22,544
New York City Inter.	21,451	2,820	2,933	*4,986
†Union	172,757	11,742	11,875	*5,931
†Westchester	41,941	2,446	2,620	*3,787
†Yonkers R. R.	52,375	1,772	1,955	*7,153
New York & Queens Co.	85,604	*19,871	*19,774	*40,725
Coney Island & Brooklyn	103,507	19,225	22,595	*1,487

*Deficit. †Operated by receivers. ‡Interest permanently defaulted is not deducted.

Total operating revenue all traction lines in New York, including Yonkers Railroad, for December, $7,078,266; net revenue from operation, $2,516,401; total income, $2,900,506; surplus after charges, $912,169.

WESTCHESTER LIGHTING COMPANY.

The Westchester Lighting Company reports to the New York Stock Exchange for the year ended December 31, 1910, as follows:

Income gas	$1,542,667	
Income electric	886,636	
Total		$2,429,303
Op. exp. taxes & res.—gas.	$1,052,208	
Op. exp. taxes & res.—elec.	473,489	
Total		$1,525,698
Net earnings from oper.		$ 903,605
Dividends received		32,540
Balance		$ 936,145
Fixed charges		853,568
Divisible surplus		$ 82,564

NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY.

The New England Telephone & Telegraph Company has issued its annual statement for 1910, which compares as follows:

	1910.	1909.
Gross	$13,171,709	$12,086,782
Operating expenses	4,956,860	4,593,172
Taxes	770,681	644,249
Repairs and depreciation	4,131,366	3,522,446
Total expense	9,858,907	8,759,867
Interest	118,808	142,966
Net	3,193,994	3,183,949
Dividends	2,350,686	2,191,866
Surplus	843,308	992,083

Total number of stations of the New England Telephone Company, December 31, 1910, was: Exchange, 253,795; private line, 5,307. Of the Southern Massachusetts Telephone Company: Exchange, 27,740; private line, 197. Of sub-licensee, associated and connected companies, 54,983, making a total of 382,022, an increase of 37,106 for the year. Wire mileage December 31 was 734,204 miles. Number of employees is 10,153.

On August 23 the Massachusetts Highway Commission, as a result of four years' study, recommended the adoption of a schedule of rates for the Boston and Suburban division. The company announces its decision to give the entire plan complete and impartial trial.

Estimated appropriations for 1911 are: For new construction and real estate, $4,000,000; for repairs and depreciation, $4,400,000, a total of $8,400,000.

AMONG THE CONTRACTORS AND SUPPLY MEN

THE ELECTRIC SHOP, Peoria, Ill., was awarded the contract for wiring the new Douglas school building there. The contract price was $1,359.

THE ROLANT ELECTRIC COMPANY, Tuckahoe, N. Y., will carry on a general electrical contracting business. Those interested in the company are George H. Rogers, Lewis S. Latimer and Walter H. Wygant.

THE NEBRASKA ENGINEERING COMPANY, Lincoln, Neb., was the successful bidder on the construction of an extension to the electric lighting system at Fort Omaha, Neb. The contract price was $1,336.

SCOTT BROTHERS ELECTRIC & MOTOR RENTING COMPANY, Detroit, Mich., moved recently from its location at No. 3-5 Farrar Street to No. 40 Macomb Street. The new factory is a three-story brick building.

THE ILLINOIS CONTRACTING ELECTRICAL COMPANY, of Rock Island, Ill., has been incorporated with capital stock of $7,000 to conduct a general manufacturing business. The incorporators are W. W. Wilmorton, Martin Messle and Frank M. Kelley.

HENRY G. PORTER, Middleboro, Mass, presented the successful bid at $29,888, for all work for the construction and completion of one four-set officers' quarters at Fort Adams, R. I., including heating, plumbing, wiring, wiring, and light fixtures.

THE AMES ENGINEERING COMPANY, Ames, Iowa., was awarded the contract to install an electric light and power plant at Jewell, Iowa, for a contract price of $12,000. The company also received the contract for the installation, at a cost of $2,000, of an electric light plant at the poor-farm at Marengo, Iowa.

FROST & SHELDON, of Albany, N. Y., have been awarded the contract for installing the new electric light plant which is to be constructed at the Hudson River State Hospital. The contract price is about $40,000. The same firm put in the present electric lighting plant which the new plant is to replace. New engines, generators and switchboard will be placed in the new power house that has already been erected at the hospital. A new distributing plant is to be installed.

ELECTROLYTIC RECTIFIER.—Please advise me what apparatus will be required to transform by electrolytic action 110-volt, sixty-cycle alternating current to ten-volt direct current, the current capacity to be at least ten amperes. Also, how to increase or decrease the current value of the direct-current circuit.—R. C., Wheatland, Wyo.

The electrolytic rectifier for other than very light currents has not been found to be a very efficient apparatus and therefore it is not used in commercial practice nor available on the market. In the case in hand, the alternating current will first have to be transformed by a step-down or auto-transformer from 110 to about 16 volts, about six volts being allowed for potential drop in overcoming the resistances of the rectifying cells, so as to leave ten volts on the direct-current side. Four cells are needed. Each of these contains an aluminum and a lead sheet, about four by five inches in area, for the electrodes. A strong solution of pure ammonium borate in pure water is used for electrolyte. The cells are connected in two series, with the lead electrodes of two adjoining cells connected together in one set and the aluminum electrodes of the remaining two cells connected together in the other set. The low-voltage side of the alternating-current circuit is connected to the outer terminals of the two sets of cells. The direct-current circuit is connected betwen the middle points of the two sets. The current capacity of the arrangement may be varied by using plates of different sizes; the larger the plates the more current can be passed, and the reverse. A rheostat in the direct-current circuit will permit of finer current adjustment. Many variations of the aluminum rectifier here described are possible, but this will probably give as good results as any.

LAMP LOAD OF AN ALTERNATOR.—How many sixteen-candlepower lamps can be lighted from a sixty-cycle alternator carrying 35.7 amperes at 2,300 volts?—W. S. H., Carlton, Ont.

The number of lamps that correspond to the load stated will depend on the type of lamps used. Assuming that a transformer is used to step down the voltage to 110 volts and that there is a loss of about four per cent in the transformer and wires, the following numbers of lamps will constitute the load given: 1,430 carbon-filament lamps; 1,970 metallized-filament lamps; 2,460 tantalum lamps; 3,930 tungsten lamps.

LAMP-RENEWAL POLICY.—If the electric light company did not make lamp renewals, would the lighting rates be lower?—V. B., Milwaukee, Wis.

Many of the larger central stations have a separate schedule of rates to apply to those consumers who wish to supply and maintain their own incandescent lamps. These rates are somewhat lower than for the bulk of the consumers who prefer to have the lighting company put in the initial equipment of lamps and renew them as they become dim or burn out. By the mass of the public the liberal renewal policy generally followed has been regarded favorably, and it certainly has been the means of maintaining the lighting equipment at a higher standard than if left to the judgment of the consumer entirely. In the latter case the tendency would be to keep the lamps in use until they give the last fading glimmer of a protracted life, with very poor resultant illumination and many complaints of supposedly bad service. The extra burden of maintaining the equipment in best condition is well worth its slightly increased cost. If a consumer wishes to put in and maintain the more efficient tantalum or tungsten lamps, he should inquire of the lighting company whether it has a reduced schedule of rates for a waiver of the lamp-renewal requirement.

MOTOR-GENERATORS OR ROTARY CONVERTERS.—We have an alternating-current plant in our building that gives sixty-cycle three-phase current at 440 volts. We wish to put in some variable-speed direct-current motors and want to know whether a motor-generator or rotary converter would be better. About fifty horsepower altogether will be used in direct-current motors.—H. M. M., Cincinnati, O.

In this case a motor-generator will probably be preferable. Even though it will have a slightly lower efficiency than a rotary, it will permit of considerable voltage adjustment and give less operating trouble than a small sixty-cycle converter. Sixty-cycle rotaries are still regarded by some engineers as unsatisfactory machines and they are not generally available on the market in small sizes.

ARCING ON THIRD RAILS.—Does the wearing down of the third rail of the elevated railroads come entirely from the friction of the contact shoes or is it also due to the arcing when there is sleet on the rails?—W. A., Chicago.

The arcing prevalent on sleety days causes pitting of the third rail and renders its surface uneven. This produces not only holes in the surface, but hastens the mechanical abrasion thereof by the contact shoe. The greatest wear is noticeable where there is the greatest amount of sparking, as at the points along stations where trains start up and at section breaks or cross-overs. Where a depression of the rail head has been caused by wear or sparking, the latter becomes more vicious and rapidly causes further wear, just as is the case with a rut in a pavement. On the Chicago Union Loop the third-rail head has been entirely worn away in several places, requiring renewal of the rail.

DIELECTRIC STRENGTH OF OXYGEN AND HYDROGEN.—Is the dielectric strength of simple gases, like hydrogen and oxygen, greater than that of air?—I. M. K., Lake Forest, Ill.

In general the dielectric strength of simple gases is less than that of air. For thickness in the neighborhood of five centimeters, the dielectric strengths are: air, 23,800 volts per centimeter; oxygen, 22,200; hydrogen, 15,100.

New Electrical and Mechanical Apparatus and Appliances.

The "Jewel" Electric Washer.

The American Washer Company, St. Louis, Mo., is now placing on the market the "Improved Jewel" electric washing machine, which is a new and improved model of its former type. A view of this machine is shown in the accompanying illustration. The revolving-cylinder type of construction has been followed in the Jewel machine in which the clothes are placed inside of a cylinder which revolves in the hot soapy water, automatically and alternately in opposite directions, forcing the water through the clothes.

The cylinder and tub of the Jewel machine are made in a thoroughly scientific manner of selected hard wood. Proper allowance has been made for swelling of the lumber when wet.

The transmission is from the motor

JEWEL WASHING MACHINE.

operated at from 1,700 to 1,800 revolutions per minute, connected with a short round belt to the grooved pulley as shown in the illustration. This pulley operates the shaft drive and the wide pulley on the outside connected with this shaft in turn drives a 1.25-inch flat belt to the triple pulley at the top of the machine. From the same drive shaft at the bottom is extended a direct shaft drive connected with bevel gears for operating the wringer. From the wringer drive shaft, by means of bevel gears, a worm gear in the center of the machine is operated which is used to move the arm through which the belt runs. This arm moves backwards and forwards by means of a cam, and shifts the belt from one pulley to the other over the center or idler pulley, and as the two outside pulleys operate in opposite directions the proper reverse is made with absolutely no "knock" or jar.

The lever at the top of the machine puts the cylinder gear in and out of mesh. At the top of the wringer will be observed a small hand-wheel. A slight turn of this wheel in either direction causes the wringer to operate one way or the other, either for wringing the clothes from the tub into the rinsing water, or back to the top of the tub ready for hanging on the line. It will also be observed that this hand-wheel is in a position where it is accessible to the operator at any instant, whether her position be in the front or back of the machine.

The Jewel machine is made in all sizes and the motors are supplied for all standard voltages, either alternating or direct current.

A New Three-Phase Motor Starter.

A new three-phase motor starter which takes care of the heavy starting load by means of paralleling the fuses in the circuit has been placed on the market by the Detroit Fuse & Manufacturing Company, Detroit, Mich., manufacturers of "Detroit" switches and "Arkless" fuses. By means of this new device it is possible to operate a motor which is only fused at its normal running load.

The "Detroit" three-phase motor starter is completely inclosed in a cast-iron box equipped with rubber gaskets, making a fume-proof and moisture-proof construction. It can be installed where exposed to very severe conditions, and is quite substantially made, so as to hold up under the roughest of handling. The mechanism is controlled by a lever, as shown in the accompanying illustrations. When throwing on the switch, the fuses are paralleled by a copper bar, as is noted in the small sketch directly above Fig. 1. It is necessary to hold this lever down until the motor has reached speed, at which time, upon the removal of the operator's hand, the lever is automatically thrown out, and the paralleling device thrown out of circuit. This leaves the fuses protecting the motor, as is noted in Fig. 2. When the operator desires to throw off the switch, it is only necessary to pull out the lever, as is noted in Fig. 3.

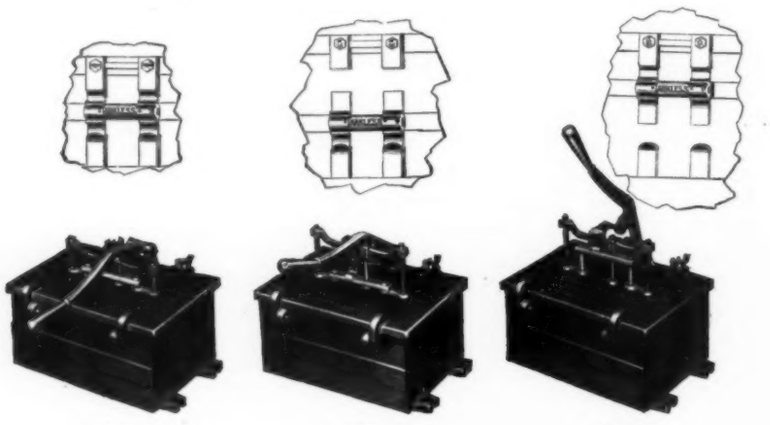


FIG. 1. FIG. 2. FIG. 3.

This switch is of the quick-make and quick-break type, with no intermediate position, and can be operated successfully even by men who know nothing of electrical apparatus. It is entirely "fool proof."

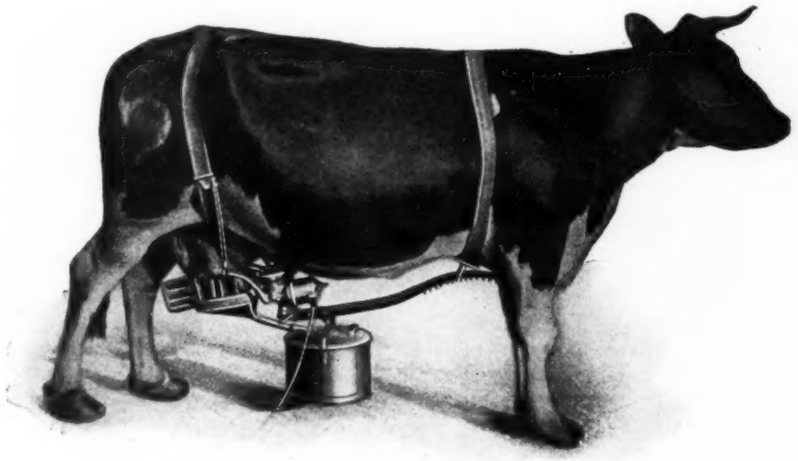
Electric-Vehicle Equipment.

The Lansden Company, Newark, N. J., has recently delivered to the Harrisburg Light, Heat & Power Company a 2,000-pound wagon equipped with sixty cells of Edison type-A-6 battery. It is rated at forty-five miles per charge at a speed of ten miles per hour.

A New Type of Milking Machine.

The milking of cows by machine is by no means a new art. In looking over statistical data we find that it reaches back as far as the early nineties, and that a great number of patents have been granted in the United States for mechanical devices designed for this purpose.

In milking machines two entirely different types are met with; one built on the principle of suction and the other on that of pressure upon the teats in a way similar to hand milking.



COW EQUIPPED WITH MILKING MACHINE.

A new make of milking machine has been invented by a Swedish engineer, A. H. Loqvist, built upon the pressure principle. It has simplicity of construction together with minute adjustment. The milking machine consists of two sets of stationary members and two sets of compressing members, *i. e.*, one set for each teat. The plates are covered with pliable rubber and attached to the machine in a way that makes them easily removable for cleaning. One set of stationary plates is rigidly connected to the middle rod, and the other set adjustable along the same rod for different distances between the teats. The compressing plates are connected to the upper and lower rods, one set rigidly and the other set adjustable, corresponding to the stationary members. The adjustment lengthwise is made so that the relative positions of the stationary and the compressing member of each set remains unchanged. The two compressing rods end with rollers sliding in a cam-grooved disk. These grooves are made so that the upper edges of the compressing plates first are pressed against the teats near the udder, then swing around the upper supporting points against the stationary plates ultimately reaching positions parallel to these and move back while kept in parallelism. In order to regulate the pressure upon the teats, the middle rod supporting the stationary plates can be moved lengthwise within certain limits, thus simultaneously altering the relative position of the compressing and stationary plate in each set and consequently the pressure also, the stroke in each case remaining the same.

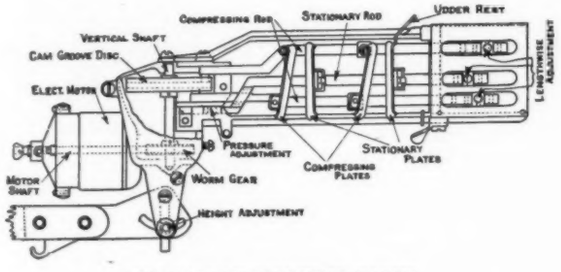


DIAGRAM OF WORKING PARTS.

In order to easily take care of the common occurrence of teats at different heights, the machine can be set and operated at any angle most suitable for the individual cow.

An electric motor is mounted on the frame of the machine and the power transmitted from the motor to the cam-grooved disk by means of a worm gear and a vertical shaft. The current required to drive the machine is somewhat less than 0.5 ampere.

The complete machine comprises besides the milker proper, as described above, a collecting vessel for the milk from the different members, a pail, and an arrangement for attaching the machine to the cow; this last being constructed so as to make transfer from one cow to another as simple as possible.

Machines of this construction have been in successful operation for over a year in Sweden, and for the last few months have been tested at the Swedish Government's agricultural research station, Alnarp, Sweden.

The machine can be seen and additional information be obtained from A. E. Sylven, 29 Broadway, New York, N. Y.

The Reed Electric Incubator.

An electric incubator, for which many claims are made, is being placed on the market by the Electric Manufacturing Company, New Orleans, La. The heating element is arranged so that a temperature of 130 degrees will never be exceeded. The machine is constructed entirely of steel and is neat in appearance and durable.

A patented heat regulator regulates the temperature to any heat desired and the makers claim that having so regulated the heat no further adjustment is necessary during the entire hatch.

The Reed incubator is built with double walls filled with granular cork, which acts as a heat insulator and at the same time allows for a slow interchange of gases without draft. Ventilating holes covered with screen mesh to retain the cork are provided in the sides to a point level with the top of the eggs. The top and sides of the egg chamber above the egg tray are solid. The ventilation secured by this arrangement is satisfactory.

MILKER REMOVED.

The Wurdack Safety Cabinet.

To provide for the safe and economical distribution of electric current in small installations, that would compare in simplicity and practicability to the panel board used in large installations, the William Wurdack Electric Manufacturing Company, St. Louis, Mo., has placed on the market the new Wurdack safety cabinet shown in the accompanying illustrations.

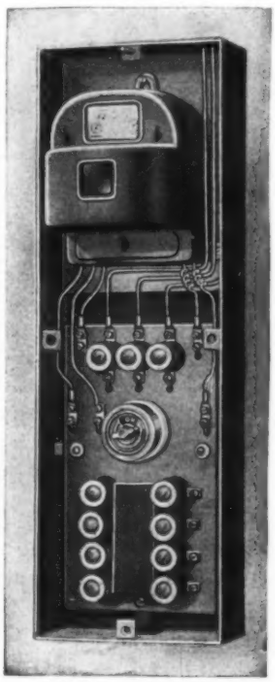
In general the Wurdack safety cabinet consists of a small special panel board contained in a sheet-iron fireproof cabinet with space provided for the installation of the current-measuring meter in this cabinet.

It is intended primarily for the control of lighting circuits in residences, apartments and stores. The main entrance fuses, the main switch and all branch-circuit fuses are mounted on a slate panel. This panel is mounted in

WURDACK SAFETY CABINET.

the lower part of a sheet-iron box. In the upper part of the box is provided a wood back to which any watt-hour meter can be attached. The panel is furnished with wire leads for connection to and from the meter; also lugs for all other wire connection. Over the front of the box fits a two part trim. The upper half has an extended portion made to accommodate any standard thirty-ampere meter. The lower half has a door covering the main fuses, a hole through which the handle of the main (rotary) switch extends, and a door covering the branch circuit fuses. When main feed wires are run into the box in conduit, the safety cabinet provides an absolutely enclosed job, all connections between every device being thoroughly protected and therefore all possible danger overcome.

The covers or trims are arranged so



INTERIOR OF CABINET.

that they can be sealed with one seal at the top; and the door over the main fuses may also be sealed, thereby preventing any tampering with the service by an unauthorized person. The door over the branch fuses is held with a plain catch and is accessible to everyone.

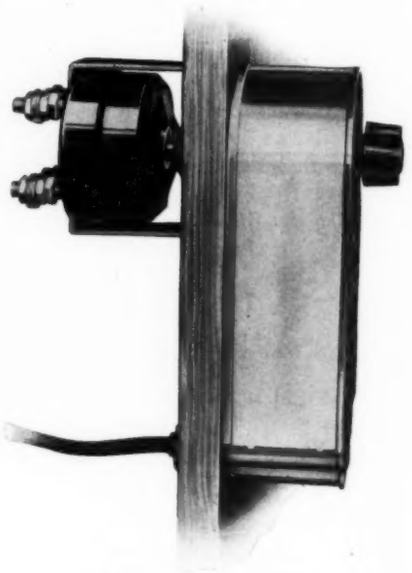
There is a glass panel in the upper part of the trim which permits reading of the meter dial without removing the case. The trims are attached to the box with adjustable angles at the top, bottom and sides—this permits them to be adjusted to fit flush against the wall irrespective of variations in the original setting of the box.

The path for the flow of current through the safety cabinet is as follows: From main entrance wires through main fuses, through main switch (the main switch is three-pole on a three-wire cabinet). The two outer legs now pass up by two wires to the left, to and through the series coil in meter, by two wires at right, back to the circuit fuses at lower part of panel. The neutral wire after passing through main switch goes directly to circuit fuses at bottom of panel. A potential tap is, however, taken from this neutral and run to the meter for the potential coil. This potential tap is the middle wire of the three wires to the left—the outer two of these three are the series wires referred to above.

The current is turned on from the outside by means of the main switch which protrudes through the trim. Should a branch circuit fuse blow, the customer renews it himself by opening the lower door. One set of fuses is furnished with every safety cabinet.

New Electric Lighting and Ignition System for Automobiles.

The Matchless electric lighting and ignition system for automobiles and motor boats, manufactured by the Esterline Company, LaFayette, Ind., possesses some very unique features, and the makers claim for it advantages which they state are not found in any other electric lighting system.

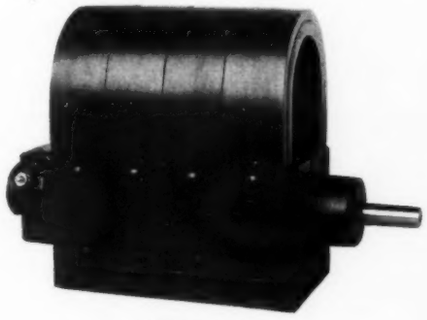


MATCHLESS CONTROLLER.

The equipment comprises a positively driven, magneto-type direct-current generator, a storage battery and an automatic, self-closing, low-voltage release, overload, reverse-current controller. The generator is made to connect directly to the pump shaft in the same manner as an ignition magneto, without the use of a speed governor or speed-controlling device. It is supplied with complete ignition equipment, which can be omitted if desired, so

that the ignition magneto can be retained or dispensed with, as the user may desire. If desired, the generator may be driven by gears or a silent chain, in case the ignition equipment is not used.

The makers state that a generator with permanent magnet fields is used for the following reasons: (1) A permanent-magnet generator will always "pick up" or begin to generate current when brought up to speed. (2) The polarity of a permanent-magnet machine can not become reversed. (3) The voltage of a magneto-type machine is only directly proportional to the speed, while in the electromagnetic-type generator the voltage is approximately proportional to the square of the speed, so that the voltage of the permanent-magnet machine varies less as the speed is changed. (4) Permanent magnet fields consume no energy and generate no heat, thereby adding to the efficiency of the generator, and at the same time reducing its operating temperature, rendering it less likely to burn out. The generator is entirely inclosed, making it dust and moisture proof and no cooling openings are required.



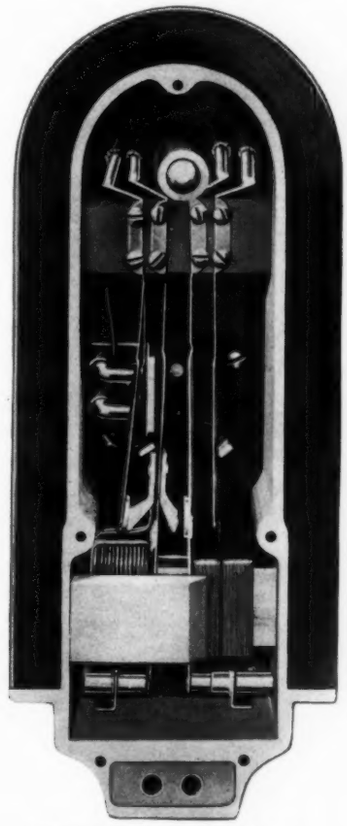
GENERATOR.

The use of a machine without the usual speed-controlling devices, it is claimed, adds greatly to the reliability of the system, and the driving of the generator at a speed at all times in direct proportion to engine speed enables the makers to combine the lighting and igniting equipment in one outfit.

In this system, the charging current is regulated and the absence of all mechanical speed control or electrical voltage-regulating devices makes the equipment extremely simple and very reliable in operation.

The use of a permanent-magnet generator is made possible by the unique electric controller which comprises a part of the Matchless system. The controller has four distinct functions, as follows: (1) to connect the battery to the generator when the voltage of the generator has reached the point where it will charge the battery; (2) to limit the current through the battery to the normal charging rate, when the generator is running at high speed; (3) to disconnect the battery from the generator whenever the voltage of the generator is less than that of the battery; and (4) to prevent the connection of the battery to the generator when the car is driven backwards.

The controller consists essentially of a die-cast metal case, over which is placed a permanent magnet, with pole pieces projecting into the case; a pair of coils surrounding the pole pieces, but capable of motion relatively to the pole pieces; a cover plate, which seals the case tightly, rendering it dust and moisture proof.



INTERIOR OF CONTROLLER.

The force moving the coils is obtained by the reaction between the field of the magnet and the current in coils surrounding the projecting pole pieces. The use of a permanent magnet in the controller has two great advantages over an electromagnet; the direction of motion depends wholly upon the direction of the current, since a permanent magnet can not become reversed, and no current is required to set up the magnetic field.

All of the moving parts of the controller are mounted on phosphor-bronze leaf springs, 0.5 inch wide, set rigidly in an insulating block. The operation of the controller is such that all electrical circuits are opened and closed at the instant the current is zero; that is to say, no currents whatever are broken, there is no sparking or burning of the brush contacts.

With the car at rest or running at slow speed, the connection between the battery and the generator is open, but when the voltage of the generator becomes sufficient to charge the battery, the circuit between the battery and the generator is closed. Should the speed continue to increase, as soon as the charging current reaches the normal charging rate of the battery, one of the coils comes into action and prevents the current from exceeding the normal charging rate.

The space occupied by the controller on the dash is 2.5 inches by 6 inches, and it extends only 1.5 inches from the dash; the weight complete is 2.5 pounds. The case is waterproof, dust-proof and ornamental in appearance. It is made entirely of metal and is, therefore, not affected by heat, cold or moisture. Only two holes are required in the dash and these are covered by the controller. There are no separately mounted parts whatever.

The cover plate forms the switch dial; a four-point, back-connected switch is used, with the stem extending through the front of the controller case. There are four positions of the switch: lights off for day running; side and tail lamps for city streets and use while the car is standing at night; head and tail lights for touring and all lights on.

All wiring is on the engine side of the dash, where it is not exposed to view. Openings are provided in the front of the controller for plug connections to an exploring lamp for use in locating trouble, filling gasoline tank, etc.

The generators are made in two sizes; the smaller size has a capacity of 7.5 amperes continuously at six volts, and is intended for use on smaller cars and boats. The larger machine has a continuous capacity of 12.5 amperes at

six volts and is designed for large cars, commercial vehicles and large boats.

The shaft is particularly heavy and rigid; the laminations of high-grade sheet steel are keyed to the shaft and the windings are imbedded in slots in the core. The generator is made of sufficient capacity to carry its rated current without overheating and without the necessity of drawing in air and dust from the outside in order to keep it cool. It is geared or connected directly to the engine shaft or an intermediate shaft without any clutches, brakes or speed-controlling devices.

The commutator is made of many segments of hard, wear-resisting material of good conductivity, and has a long life. The permanent magnets are made of the very best grade of tungsten steel, carefully treated and guaranteed not to deteriorate.

An inclosed junction box is supplied with each equipment. This box is of sheet metal, with a removable cover, and contains a small insulated panel board, with provision for the necessary fuses for each circuit, and connections for all wires. It is stated that this junction box greatly facilitates the wiring of the car and gives an orderly arrangement to the circuits. The points for connection in the box and the wires leading in are labeled so that an inexperienced person can connect up the system.

An eighty-ampere-hour battery is used with the small size and a 100-ampere-hour battery with the large size, and on account of the fact that it is impossible to overcharge the battery with this system, any first-class storage battery can be used.

The equipment has been subjected to the most severe trials, both in the laboratory and in actual service, and is offered as a lighting equipment which, in point of durability, simplicity and reliability, is equal to the automobile itself. The controlling device is the invention of Albert E. Berdon and the controller and the generator were designed by Mr. Berdon and J. W. Esterline.

Telephone Train Dispatching.

The Queen & Crescent System has completed the construction of a telephone train-dispatching circuit paralleled by a local-message telephone circuit on the second district of the Cincinnati, New Orleans & Texas Pacific Railway which extends from Danville, Ky., to Oakdale, Tenn., a distance of 134 miles. Although most of this division is double-tracked, traffic is very heavy and the train-dispatching circuit is an unusually busy one. Gill selectors are used in this installation.

A New Line of Convertible Switchboards.

The Western Electric Company has just placed on the market a new line of telephone switchboards, which will fill a long-felt want among small telephone companies. This type, known as the magneto convertible non-multiple switchboard, is so designed that it can be used originally for magneto service and then converted at will for central-battery operation.

These convertible switchboards are recommended for use in new exchanges

CONVERTIBLE TELEPHONE SWITCHBOARD.

where the present conditions call for magneto service, but where central-battery service will eventually be used. Their use makes possible the greatest economy right at the start when magneto service is required. Later when it becomes more economical to operate the exchange on a central-battery basis the common-battery lines can be added as needed, and the switchboard will operate just as economically as a central-battery equipment. Oftentimes it is advantageous to make this change from magneto to central battery gradually. This convertible switchboard allows both kinds of service at the same time.

The magneto exchange requiring additional lines to take care of its growing business until the time when it will find central-battery operation more economical, will find these convertible switchboards money-savers. One or more sections equipped for magneto service can be installed, and when the time comes for changing to central-battery operation the transition can be made without any loss of equipment.

These switchboards are made in two sizes, the No. 1256, having a capacity of 330 magneto or common-battery lines, thirty pairs of cords and thirty transfer circuits, and the No. 1246, having a capacity of 165 magneto or common-battery lines, fifteen pairs of cords and fifteen transfer circuits. They are so designed and constructed that any number of sections can be readily lined up together, so as to make a switchboard with several positions without making a single change in the woodwork of the cabinet, and the sections when so arranged present the appearance of one continuous cabinet.

An important feature of these switchboards is the cord circuits. These circuits are extremely flexible, for, without disturbing the wiring of the board and adding but a few pieces of apparatus five different combinations can be made, as follows: (1) straight magneto (without condensers), (2) magneto with "non-hang-up" feature; (3) combination cord circuit capable of connecting two magneto lines or one magneto line and one central-battery lie; (4) special combination cord circuit, capable of connecting two central-battery lines, one magneto line and one central-battery line; (5) universal cord circuit, capable of connecting two magneto lines, two central-battery lines or one magneto and one central-battery line; and (6) straight central, capable of connecting two central-battery lines.

Any of these changes can be made easily and quickly. For example, the addition of the converting relay, which changes the cord circuit from magneto to common-battery operation, is made by simply cutting the loop wires back of the switchboard and soldering the relay.

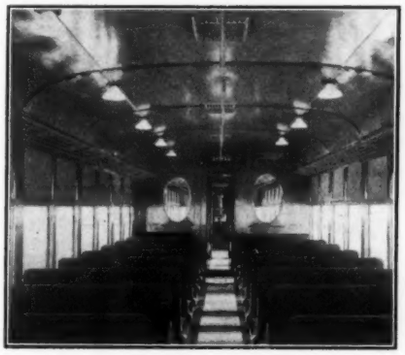
The well known combined jack and signal, used in this company's No. 1800-type switchboard, is used in this board, and most of the apparatus used is standard, having been employed in many of the company's switchboard circuits for years.

Gas-Electric Car for Buffalo, Rochester & Pittsburg Railway.

The General Electric Company has just delivered a gas-electric car to the Buffalo, Rochester & Pittsburg Railway. On April 18 the car proceeded to its destination over the lines of the New York Central Railroad with a party of officials of the railroad and General Electric Company aboard. Due to the absence of smoke, cinders and gas, the passengers enjoy the advantages of electric railway travel in addition to the comforts of Pullman service.

This type of car is admirably adapted for use on branch lines which at present may be operated at a loss by steam and where the amount of traffic does not warrant electrification, and its use on such lines will invariably reduce operating expenses and increase traffic.

The car is 66 feet long, 14 feet high and has a seating capacity of forty-nine in the passenger compartment and twenty in the smoking compartment, with two pasengers per seat. The seats are sufficiently wide to accommodate three persons, so, if desired, the passenger compartment will accommodate sixty-nine and the smoking compartment twenty-eight.

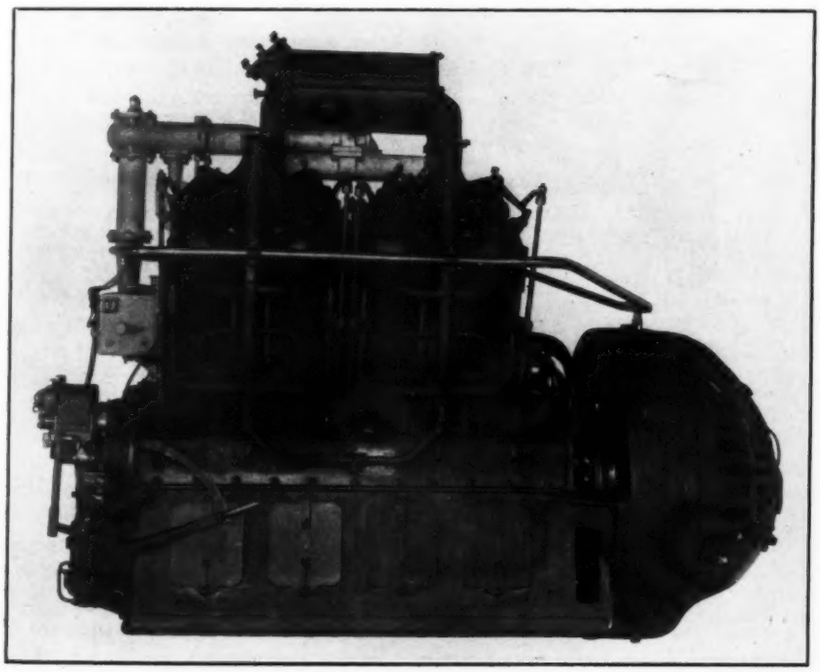


INTERIOR OF CAR.

The General Electric car derives its power from a gasoline engine and transmits it to the wheels by means of an electric drive, thus avoiding any direct mechanical gearing or connection between the engine and the wheels. The engine is direct coupled to an electric generator, forming a compact power plant located in the engine compartment. The electric power thus generated is applied to standard railway motors, mounted upon the axles. The car is operated by means of a suitable controller in a manner similar to ordinary electric trolley cars. A 100-gallon storage tank supplies sufficient gasoline to carry the car over 200 miles.

The car is provided with automatic and straight air-brake equipments and auxiliary hand brake for use in case of emergencies. It is also equipped with standard automatic air signals.

All members of the party mentioned above were greatly pleased with the performance of the car, which made the trip of 244 miles from Schenectady to Rochester via the Auburn division on time at every point and without delay of any kind. The smoothness of operation and ease of control were subjects of most favorable comment, and the speed attained on the heavy grades of the Auburn road were highly satisfactory.



GAS-ELECTRIC UNIT FOR RAILWAY CAR.

Ampere-hour Meters for Electric Vehicles.

In a paper bearing this title, presented before the Electric Vehicle Assocation of America on April 25, R. C. Lanphier described the ampere-hour meter as used on electric vehicles and pointed out its advantages. While an ammeter and voltmeter show the instantaneous conditions, they do not indicate the state of charge as is done by the ampere-hour meter. The latter may be arranged with a differential shunt, so as to record faster on discharge than on charge. The ratio of the two rates can be adjusted to suit the ampere-hour efficiency of the battery. The meter will then run just as far back on charge as it runs forward on discharge, and its condition with respect to charge is evident at all times. The meter can be arranged to automatically control a circuit-breaker in the charging circuit, and thus stop the charging current when the battery has received the proper charge. Meters can also be arranged for totalizing the charge or discharge. Such meters record only when the current passes in one predetermined direction. Recently a type of meter has been designed in which the charge and discharge are recorded separately on two sets of dials. The two records may be made to show kilowatt-hours input and ampere-hours output.

Tests of Enamel Magnet Wire.

The Feval Enamel Insulated Wire Company, 124 North Curtis Street, Chicago, Ill., is publishing, in its Bulletin No. 21, the results of tests on Feval enameled magnet wire conducted by the Armour Institute of Technology.

From these tests the company derives the following conclusions: Enamel insulation has a higher dielectric strength than silk or cotton insulation; will withstand more heat without deterioration; occupies less space than single silk insulation and weighs less than fabric insulation.

Central Vermont Uses Telephones for Train Dispatching.

The Central Vermont Railway has installed a system of train-dispatching telephones between St. Albans and Windsor, with a branch from Montpelier Junction to Williamstown, a distance of 150 miles. Heavy copper wire, weighing 210 pounds per mile, with transpositions at one-quarter-mile intervals, is used.

At each of the thirty-eight way stations on this division selectors and telephone sets have been installed. The Van Akin telephone arm is used by the way-station operators, and the selector, arresters, protectors, knife switches and battery box have been mounted upon a board.

At the dispatcher's office also, the terminal equipment is mounted on a single board, which is hinged for convenience in maintenance work. This apparatus includes retardation coils and condensers, switches, protectors, a telegraph relay, by means of which direct-current impulses are sent out on the line, and keys for cutting off telephones loops around the St. Albans office. A head receiver and chest transmitter complete the telephone equipment in the dispatcher's office. All of the equipment used on this road was ordered from the Western Electric Company and was installed under the direction of M. Magiff, superintendent of telegraph.

A New Leakage Detector.

The Winhey leakage detector has been designed to instantaneously cut off the supply of current to mining apparatus, when an appreciable leak to ground occurs. It operates with such a degree of sensitiveness as to isolate entirely an installation the instant that a fault takes place, and before a sufficient leak can be maintained long enough to cause any danger of accidents through shock or fire. With an instrument of this description the limit of leakage is so small that it might be supposed that its use would be practically impossible in connection with colliery installations, and would cause constant stoppages due to the supply being interrupted from slight leakage; but it has been proved that if a reasonable amount of care is exercised, such is not the case. One of these instruments has been subjected to an exhaustive trial, extending over twelve months, on a colliery installation of moderate size, and during this period it only came into operation twice through ordinary natural breakdown causes. With these two exceptions, it was not found to constitute any hindrance to the working of the mine.

The Maytag Electric Washer.

A washing machine, which the makers claim will fulfill successfully all of the requirements of a power washing machine, is being placed on the market by the Maytag Company, Newton, Ia. One of the principal features of this machine is its single operating lever, which controls the washer and ringer, starting, stopping, or reversing, as the case may be, without the confusion of separate levers.

MAYTAG WASHER.

The general design of the Maytag Washer is very simple. As may be seen in the illustration, a vertical steel shaft, carrying a bevel gear at the lower end and a disk carrying a crank pin at its upper end, is mounted on the side of the tub. At the lower end of the shaft and just under the bevel gear is mounted a horizontal steel shaft carrying two bevel pinions which mesh with the bevel gear on opposite sides. On the outer end of this shaft is fastened the driving pulley and on the smaller shaft, between the two pinions, is placed a sliding clutch. When this clutch is moved so as to engage with either of the pinions the machine starts and when the clutch is shifted to engage with the opposite pinion the machine is reversed.

On the opposite side of the tub is mounted a vertical rod having a handle on the upper end and its lower end attached to a rod running underneath the tub and fastened to the clutch. This handle controls the operation of both washer and wringer.

The Maytag Washer consists of a tub of southern cypress and a dolly of hard maple which adjusts itself up or down according to the amount of clothes being washed. The dolly is driven by a cog wheel meshing with a rack bar which receives its to and fro motion by having one end fastened to the rotating disk pin.

World's Largest Arc-Lamp Order.

The Union Gas & Electric Company, of Cincinnati, has just placed with the General Electric Company, at Schenectady, N. Y., the largest single order for arc lamps ever received by a manufacturer. This order calls for 6,000 of the company's latest type of series luminous arc lamps, together with a complete mercury-arc-rectifier station equipment of 9,000 lamps capacity.

This order, twice as large as any previous lamp order, and reaching a total value close to half a million dollars, is highly significant of the rapidly increasing popularity of this type of lamp. And, when the six thousand new lamps are installed in Cincinnati, that city will rank with Boston, St. Louis, Toledo, Montreal and Baltimore, which use the same type of lamps.

Money Saved by Smoke-Consuming Stokers.

The Waverly Company, of Indianapolis, which manufactures the Waverly electric car, made an interesting trial of a smoke consumer which shows something of the practical economies obtainable through the automatic stoker. It is now five years since the stokers were installed, and through this improvement a total of about $7.00 per day has been saved.

A comparison of the smoke at various times showed that before the installation was made twenty-eight per cent of the time there was black smoke, forty-six per cent dense or worse, and sixty-three per cent gray or worse. At the present time there is no black smoke, one-half of one per cent of dense and only ten per cent of gray. Jones underfeed stokers are used.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

Beginning June 1, the New York Edison Company will put into effect a reduction in the price of tungsten electric lamps according to a new tariff just filed with the Public Service Commission. This will be the third reduction in the price since these lamps were introduced in the early part of 1908.

The forty-watt tungsten lamps, after June 1, will be sold to customers entitled to free renewals at thirty-seven cents each, the sixty-watt lamps at fifty cents each and the 100-watt lamps at sixty cents each. In 1908 the prices of these lamps to free renewal customers were respectively $1.00 for the forty-watt lamps, $1.25 for the sixty-watt lamps and $1.50 for the 100-watt lamps. According to the tariff now in force the forty-watt lamps are sold to free renewal customers at forty cents, the sixty-watt lamps at fifty-two cents and the 100-watt lamps at sixty-two cents.

According to a statement made by John W. Lieb, Jr., associate general manager of the New York Edison Company, the company has under consideration a general revision of its rate schedules. This is something which the Public Service Commission has been trying to bring about for some time. Commissioner Milo R. Maltbie during the last two years has conducted a general investigation into the rates and contracts for the supply of electric current in the city and has been urging upon the representatives of the company a reduction and general rearrangement of rates. Mr. Lieb's statement was made at a recent hearing before Commissioner Maltbie in the case of the Long Acre Electric Light & Power Company, which is applying for permission to issue additional stock and bonds.

On Monday the Commission heard at Albany the complaint of the Postal Telegraph Company against the Western Union Telegraph Company as to alleged discrimination in the charge for words inserted on telegrams which the Postal Company is required to deliver the Western Union Company in order to make final delivery where the complaining company has no office. The Commission also gave a hearing upon the application of the Empire Gas & Electric Company for authority to issue $900,000 in common capital stock and $2,400,000 in five-per-cent first and refunding thirty-year gold bonds to be secured by a first and refunding mortgage for $5,000,000. The Empire Gas & Electric Company is a new corporation which proposes to acquire all of the stock of and merge into itself the Interurban Gas Company of Geneva, including the Geneva Gas Company and the Seneca Falls & Waterloo Gas Company, the Auburn Light, Heat & Power Company, the Auburn Gas Company, the Citizens Light & Power Company, and the Auburn Subway & Electric Company. All of these companies are engaged in the business of supplying gas in one or more of the cities of Geneva and Auburn, the villages of Waterloo, Seneca Falls and Cayuga, and intermediate towns.

In response to an inquiry as to the precise attitude of the Brooklyn Rapid Transit Company toward the matter of extensions President Williams said that the company had offered to operate any or all extensions which the city might build now or in the future. It did not assume, however, to determine which of these extensions should be given the preference, leaving that question to be determined by the city; but the company's own conviction is, that inasmuch as it will probably take four years to construct the trunk line subway, and less than two years to construct elevated extensions, it will be possible, if the city is so disposed, to have all these extensions ready for operation by the time the trunk line subway is completed. The Public Service Commission, First District, observes that the statement made by Colonel Williams of the Brooklyn Rapid Transit Company covers only operation of extensions, and does not contain any promise in reference to constructing these extesions. The statement issued by Colonel Williams shows that the company is willing to operate these lines if the city will build them, and in that case it is presumed that the company would wish to have special terms agreed upon for such operation, so as to provide against loss until the localities become more densely settled.

LIGHTING AND POWER.

(Special Correspondence.)

MASON CITY, IOWA.—Six blocks of electroliers will be installed this summer. C.

CUSTER, IOWA.—A stock company has been organized here to install an electric light plant.

CRYSTAL FALLS, MICH.—The city is planning the construction of an electric light plant. C.

ST. VINCENT, MINN.—It is proposed to raise $4,000 with which to put in an electric light plant. C.

MONTGOMERY CITY, MO.—A twenty-year franchise has been given to the Stover Electric Light Company, which will give night and day service to the village.

INDEPENDENCE, IOWA.—Work has been started on the installation of electroliers on Main Street. C.

SEATTLE, WASH.—The city is planning the erection of a 32,000-horsepower plant on the White River. C.

TULIA, TEX.—This city has voted electric light bonds and waterworks bonds to the amount of $25,000. P.

ALVIN, TEX.—The Alvin Ice, Light & Power Company has been incorporated with a capital stock of $15,000. P.

FOND DU LAC, WIS.—The Business Men's Association is planning the installation of a system of ornamental lighting. C.

DORRIS, CAL.—The Siskiyou Light & Power Company has applied for a franchise to furnish this city with electric light. A.

SCRANTON, PA.—An ordinance was recently passed providing for the installation of eighty-six arc lamps in various parts of the city.

RALEIGH, N. C.—The North-State Hydroelectric Company, with a capital stock of $300,000, recently filed papers of incorporation.

SUN PRAIRIE, WIS.—A vote will be taken May 9 on issuing bonds for $9,000 to the state for the installation of an electric light plant. C.

VILLISCA, IOWA.—Plans are being made for the lighting of this city from the power plant at Clarinda. Another scheme includes the construction of a local plant.

MOBRIDGE, IOWA.—A franchise has been granted to the Mobridge Electric Light, Power & Heating Company to install an electric light plant and work will be started at once.

TROUP, TEX.—The local electric light and power plant has been purchased by R. C. Shumate of Zephyr from Clark Finch. Mr. Shumate will make improvements and extensions. D.

CLAREMONT, CAL.—The Pacific Light & Power Corporation has been granted a fifty-year franchise for lighting Mills Avenue from North First Street to the north city limits.

COLEMAN, TEX.—The Briggs-Weaver Machinery Company of Dallas has been awarded the contract for the construction of the new electric-light station here. The building will be of concrete.

WINONA, MINN.—The Minnesota-Wisconsin Power Company, which plans to secure control of a number of power plants in Minnesota, has applied for a franchise to string wires for power purposes only. C.

MENASHA, WIS.—The council is considering the installation of two Deisel engines of 225 horsepower. An addition will be made to the power house at an estimated cost of $30,000 for which it is proposed to issue bonds. C.

IMBODEN, ARK.—The Imboden light and power plant has been sold by the People's Bank to George Dutton, a machinist of this city, who has assumed management of the plant. Improvements and extensions are to be made.

NEWPORT NEWS, VA.—The ordinance asking for an election on a bond issue of $150,000 for the erection of a municipal lighting plant here has been signed by the mayor. The election probably will not be held before September.

TROY, ALA.—A $50,000 electric light plant is to be erected by the Standard Chemical & Oil Company and the company will use motor-driven machinery in its works. The change was made necessary by the great growth of business.

MIDDLETOWN, O.—The Middletown Gas & Electric Light Company has absorbed the plant and holdings of the Middletown Lighting Company. The sale was made in consideration of $150,000 and the transfer took place May 1.

ALBION, ILL.—The Albion Electric Light & Gas Company has been incorporated with capital stock of $20,000 to maintain an electric lighting system and gas plant. The incorporators are W. H. Broadman, H. M. Knipe and W. A. Achock. Z.

FORT STOCKTON, TEX.—The City Council has granted W. F. Zarbach and Charles A. Shroff, of Cleveland, Ohio, a ten-year franchise to operate an electric light and ice plant. The franchise calls for work to commence immediately, a $20,000 plant to be installed. D.

EUREKA, CAL.—The holdings of the Arcata Lighting Company have been taken over by the Western States Gas & Electric Company. The purchasing company announces that there will be no material change in the system or policy of the business as operated by the Arcata Company. A.

CHICO, CAL.—A conduit system is soon to be installed in the

business section of this city, for the power, light, telephone and telegraph wires. The Pacific Gas & Electric Company and the Sacramento Valley Power Company announce that they will begin work on the new system in a short time. A.

MORRIS, MINN.—S. Stewart is planning the installation of a 200-horsepower engine, new dynamo and other improvements at the electric light plant. C.

WALLA WALLA, WASH.—The Pacific Light & Power Company announces that it will soon begin the construction of a transmission line from this city to Dayton, by way of Dixie, Prescott and Waitsburg. The line will cost about $50,000. A.

QUINCY, CAL.—Harold R. Ebright, of San Francisco, has deeded to the Ora Water, Light & Power Company water rights aggregating 60,000 inches of the water of four creeks flowing into the North Fork of the Feather River. A power house is to be constructed on the bank of the Feather River, near the mouth of Yellow Creek. A.

CAMDEN, O.—The Camden Electric Light & Milling Company is planning to supply College Corner with power, building a new line for the purpose. The company already has a plant at Coke Otto and will build another at Woodsdale, and expects to supply Seven Mile, Somerville, Camden, Trenton, Morning Sun and other towns with electric power.

MEDINA, N. Y.—The A. L. Swett Electric Light & Power Company, which supplies current to Medina, Middleport, Gasport, Albion and Brockport, has made a proposition to the village trustees of Holley to take over the municipal plant of that town for the sum of $10,000. In addition it will light the clock tower and also furnish the village hall with light.

FREMONT, O.—An electric line is being promoted from this city to Port Clinton, a distance of eighteen miles, furnishing an outlet to the lake and fruit growing country. The same line has been projected by the Toledo, Port Clinton & Lakeside Railway and others, but for some reason has never been built. F. D. Carpenter and J. D. McDonald are now back of the movement. H.

DEL RIO, TEX.—The preliminary surveys for an extensive system of irrigation and a large hydroelectric plant that are to be established on the Pecos and Devil's Rivers in the Del Rio section by a syndicate in which ex-Governor David R. Francis of St. Louis, Mo., is largely interested are now being made. It is announced that more than $5,000,000 will be invested in the enterprise. D.

GALVESTON, TEX.—The Federal Government, through Major C. P. Howell, United States engineer in charge of the Galveston district, has let the contract for laying the telephone and electric-light and power cables and an eight-inch water main on the dike from a point opposite Fourteenth Street to the site of the government immigrant station to C. K. Spalding and Thad. Parsons. D.

ALTUS, OKLA.—The Southern Electric Company of Altus, Okla., has recently been granted a charter. This company is incorporated for $10,000; capital fully paid up, and will at once engage in the electrical construction business. The chief offices of the company will be at Altus, where all of the incorporators live. The men back of the organization are M. E. Woolridge, W. R. Kimberlin, and E. E. Traweelmail.

SAN FRANCISCO, CAL.—The Massie Company announces that it will soon begin the construction of two new power stations, one to be located at San Diego and the other at Balboa, Cal. When these plants are completed, the company will be able to handle the business of all the steamers on this coast, carrying the Massie wireless. An auxiliary plant has been located on the roof of the Phelan Building in this city. A.

FOXBORO, MASS.—The South Eastern Massachusetts Electric Company has been incorporated with a capital of $150,000 for the purpose of generating, purchasing and selling electricity for light, heat and power. The incorporators are: Philip Cabot, of Boston; Frank H. Coyne, of Foxboro; and Charles S. Davis, of Boston. It is the purpose of the company to purchase and develop existing plants now in the counties of Norfolk, Bristol and Plymouth.

AUSTIN, TEX.—The J. T. Cogan Company of New York has submitted to the City Council a proposition to rebuild the dam across the Colorado River and install a hydroelectric plant here. It purposes to replace the dam and hydroelectric plant at a cost of $1,000,000, which shall be paid by the city at the rate of $50,000 per annum from the earnings of the waterworks and electric plant and power departments. This proposition and others will be referred to the pepole at an election that will be called in the near future. D.

OAKLAND, CAL.—Plans for improvements to the electric lighting system of the Oakland Gas, Light & Heat Company have been practically completed. The plant of the company is said to have been inadequate to its requirements for some time, and a contract was recently closed for the installation of a turbine generator of 16,000-kilowatt capacity. This will require about 10,000-horsepower additional boiler capacity, and the improvements, when completed, will practically double the present plant. It is expected that the new equipment will be operating by November, and in the meantime a material extension of the distributing system will be made, the wires being placed underground in the central part of the city. A.

ELECTRIC RAILWAYS.

(Special Correspondence.)

IOWA CITY, IOWA.—The Iowa City Railway Company has commenced the construction of a line to the city park. C.

BREMERTON, WASH.—The construction of an electric interurban line to the Grays Harbor country is being agitated. C.

CORVALLIS, WASH.—The Albany Interurban Railway Company has been granted a franchise to operate a street railway in this city. A.

HELENA, MONT.—The Helena Light & Railway Company will issue bonds for $100,000 for the construction of a double track to the state fair grounds. C.

ST. PAUL.—The St. Paul Southern Electric Railway Company has secured practically all the franchises and rights of way for the line which it proposes to build within the next two years. C.

SACRAMENTO, CAL.—The Pacific Gas & Electric Company has applied for a franchise for a street railway line on Thirteenth Street from K to I Streets, on I from Sixteenth to Twenty-first and on Twenty-First to P Streets. A.

OMAHA, NEB.—The Nebraska Transportation Company let the contract to the Baker Construction Company, Omaha, for 284 miles of interurban lines to Sioux City, Iowa; Elk City, Decatur, Norfolk and other towns in Nebraska. C.

CHEHALIS, WASH.—The Twin City Light & Traction Company has been granted a light and power franchise in this city. Work will commence this month on the new $75,000 power house of the company to be installed on Coal Creek. A.

ST. MARYS, O.—The Western Ohio Traction Company has closed a fourteen year lease on commodious quarters in the Palm Hotel block to be used as a ticket office and station for the Pacific Express Company. Removal will be made to the new rooms in a very short time. H.

DALLAS, TEX.—The East Texas Traction Company is preparing to construct an interurban electric railway between Dallas and Terrell, Texas, a distance of about thirty miles. The proposed road will traverse a populous section. C. L. Wakefield is at the head of the project. D.

VINCENNES, IND.—The Vincennes North and South Traction Company has filed articles of incorporation capitalized at $100,000. The company proposes to build an interurban electric line to connect Vincennes and Sullivan and intermediate towns in Knox and Sullivan counties. J. M. House, B. M. Willoughby and E. D. Logsdon, directors. S.

PALESTINE, TEX.—Ralph E. Hoskat, of Dayton, and associates are promoting the construction of a system of electric street railway here. They have submitted a propostion to the people of the town agreeing to construct the system if they are given a bonus of $30,000. The proposition is now being considered by a committee of citizens. D.

WASHINGTON, IND.—Perry township, Martin county, has voted a one-per-cent subsidy tax in aid of the construction of the Washington and Eastern Traction Company's line between Vincennes and Washington. Four other townships will likewise vote on the subsidy proposition in a few days. The amount of the subsidy asked aggregates $180,000. S.

FORT DODGE, IOWA.—The construction of an interurban line to Gilmore City and possibly Spirit Lake is being discussed. Plans, in which E. T. Meredith, Geis Botsford, J. R. Martin and others of Des Moines are interested, are under way for the construction of a hydroelectric plant, ten miles below here, of 4,000 to 6,000 horsepower, to cost approximately $612,000. C.

REDWOOD CITY, CAL.—The Redwood City Railway Company has been incorporated by Geo. A. Merrill, Geo. W. Lovie, V. V. Greco, W. J. Drew and C. F. Morrison, with a capital stock of $125,000. The new company proposes to operate a railroad from a point half a mile south of the county courthouse northeasterly to a point on San Francisco Bay, a distance of five miles. A.

SOUTH BETHLEHEM, PA.—The Hallertown & Richlandtown Electric Railway Company, capital, $36,000, recently applied for a charter. The road will be six miles in length, extending from the terminus of the Lehigh Valley Transit road at Hallertown, through Leithsville, Passer and Richlandtown. The incorporators are Justice A. R. Trumbauer, Benjamin Huttel, Jacob Apple and Eugene Leith.

PIERRE, S. D.—Articles of incorporation have been filed for the Sioux Falls and Southern Minnesota Traction Company, with a capital of $300,000, and headquarters at Pierre. The company is incorporated by L. B. Wyckoff of Syracuse, N. Y.; J. J. Davenport, H. W. Knight, Charles S. Sollars of Chicago; G. P. Peterson, Pierre. The company proposes to construct an electric line between Sioux Falls, S. D., and Albert Lea, Minn.

WASHINGTON, D. C.—The Washington, Spa Spring & Gretta Railway is trying out an Edison storage-battery car having a seating capacity of twenty, and capable of running at twenty-five miles an hour; a second car of similar construction will be put on by June 1; a small charging station has been located at each end of the line; the one to be received in June will have a capacity of thirty-two persons and will be equipped with four twelve-horsepower motors. F.

ARLINGTON, VA.—The Arlington Electric Company has been chartered with a capital stock of $100,000 for the purpose of extending electric lines in Alexandria and Fairfax County; the officers are M. E. Church, President and general manager, of Falls Church, Va.; E. Wiley Stearns, treasurer, Rosslyn; L. L. Northrop, treasurer, Clarendon, at which place the general offices of the company will be located. The company will furnish power and light through this portion of Virginia. F.

TEXAS CITY, TEX.—The Texas City Transportation Company has arranged for the installation of electric carriers in its warehouse which is devoted to the New York business at this point. If these carriers prove satisfactory it is the intention to equip all of the warehouses with them. The carriers are built in section and will be so installed that they may be run into cars, expediting the loading and unloading. Where ships have side ports the carriers can be run into the holds, thus doing away with trucking. The company will also equip its pier with electric cranes to handle cotton and miscellaneous freight. D.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

COUNCIL BLUFFS, IOWA.—The Independent Telephone Company is enlarging its plant. C.

TYLER, TEX.—The Talbert Telephone Company has been incorporated with a capital stock of $25,000. P.

WILLMAR, MINN.—A franchise to install a telephone system and exchange has been granted to Arthur C. Bowe. C.

WEVERTS, NEB.—The Farmers Mutual Telephone Company has been incorporated with a capital stock of $2,000. P.

WAUNETA, NEB.—The Wauneta Farmers Telephone Company has been incorporated with a capital stock of $24,000. P.

GLENDIVE, MONT.—The Bell Telephone Company will expend $25,000 on improvements for its Judith Basin lines. C.

EDGAR, WIS.—The Marathon County Telephone Company has commenced the construction of a line to the towns of Wein and Frankfort. C.

LIBBY, MONT.—Work will be started this year on the construction of a complete telephone system for the Kootenai National Forest, to center here. C.

CLEARBROOK, MINN.—Erick Lindom and L. Halverson are interested in the construction of a telephone line, fifteen miles long, to Neving and other points. C.

OGDENSBURG, WIS.—The Ogdensburg Telephone Company has been incorporated with a capital of $4,000. The incorporators are W. G. Lytle, J. C. Johnson and A. E. Freagen.

SAVANNA, OKLA.—The Savanna Celestine Telephone & Telegraph Company has been incorporated with a capital of $5,000. The incorporators are L. L. Georgia, Frank Savage, W. J. Shephard, P. W. Fennell and J. W. Jennings.

NEW LEBANON, IND.—The New Lebanon Mutual Telephone Company has filed articles with the Secretary of State. The capital stock is $3,500. The object of the company is to build, equip, maintain and operate telephone exchanges, telephone lines and appliances in New Lebanon and through Sullivan county. The incorporators are: J. K. Coulson, Arthur Brown, G. D. Schaffer, W. R. Willis and L. C. Baughman. S.

ELECTRICAL SECURITIES.

When compared with the same week of previous years the trading appears to be rather light, but there has been a marked improvement over the previous weeks, and the advance in prices has been general. One development of the week is the plan for financing the Northwestern Elevated Railroad of Chicago. The scheme involves the issuance of $30,000,000 in three-year notes. There has throughout the country been a marked investing movement which may be considered as a sequence to the general ease in money conditions.

The $12,875,000 five per cent convertible debenture bonds of the General Electric Company may be exchanged for stock at par on and after June 1 next.

Chicago Railways earnings for twenty-three days of April increased ten per cent and Consolidated Traction earnings increased nineteen per cent, making an increase of combined systems eleven per cent. Chicago Railways proper has shown well above $50,000 every Saturday for several weeks.

J. P. Morgan & Co. have bought $10,000,000 one-year four and one-half per cent notes of the Interborough Rapid Transit Company, the proceeds of which will be used primarily to take up $4,584,000 three-year six per cent notes maturing on May 1. The remaining $5,516,000 will be used to recoup the treasury on account of extraordinary expenditures for equipment and construction paid out of current earnings.

Stone & Webster are offering on behalf of Pacific Coast Power Company an additional issue of $772,000 six per cent cumulative preferred stock at par. This company is building a hydroelectric plant on the White River within twenty miles of Seattle and fifteen miles of Tacoma, which it is estimated is capable of an ultimate development of 80,000 horsepower. The first development of approximately 27,000 horsepower, for which there is an immediate market, should be completed in the fall of 1911.

The New York Stock Exchange has listed $2,481,000 additional Westchester Lighting Company first mortgage five per cent fifty-year gold bonds. This makes the total listed and outstanding $8,397,000 out of $10,000,000 authorized. Of the $2,481,000 bonds, $1,391,000 have been held in the Westchester Lighting Company treasury and known as treasury bonds. They had been pledged as collateral for loans made by the Consolidated Gas Company and were released by payment of the debt.

DIVIDENDS.

American District Telegraph Company, of New York; regular quarterly dividend of one per cent payable May 15 to stock of record May 1.

North Shore Electric; quarterly dividend of one per cent, payable May 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	May 1.	April 24.
Allis-Chalmers common	7	7¼
Allis-Chalmers preferred	27½	26
Amalgamated Copper	63⅛	61⅛
American Telegraph & Cable	*80	*80
American Telegraph & Telephone	145½	144¾
Brooklyn Rapid Transit	78¾	76⅝
General Electric	158½	150¾
Interborough-Metropolitan common	18	17¼
Interborough-Metropolitan preferred	51	48¼
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	89	90½
Mackay Companies (Postal Telegraph and Cables) preferred	75	75
Manhattan Elevated	135	135
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Telephone & Telegraph	49½	48
United States Steel common	75⅜	73⅝
United States Steel preferred	120½	119
Western Union	73½	71½
Westinghouse common	69½	64½
Westinghouse preferred	110	110

*Last price quoted.

BOSTON.

	May 1.	April 24.
American Tel. & Tel.	145¾	144¾
Edison Elec. Illuminating	286	285
General Electric	158¼	150¾
Massachusetts Electric common	17¼	16
Massachusetts Electric preferred	87	86¾
New England Telephone	141	140
Western Tel. & Tel common	18	18
Western Tel. & Tel. preferred	93	92

PHILADELPHIA.

	May 1.	April 24.
American Railways	44¼	44¾
Electric Company of America	12	11⅞
Electric Storage Battery common	52½	52
Electric Storage battery preferred	52½	52
Philadelphia Electric	16⅜	16⅛
Philadelphia Rapid Transit	17¾	17½
Philadelphia Traction	82	82½
Union Traction	46¼	45½

CHICAGO.

	May 1.	April 24.
Chicago Railways, Series 1	80	80
Chicago Railways, Series 2	22	22
Chicago Subway	5	4¾
Chicago Telephone	121	121½
Commonwealth Edison	124	123½
Metropolitan Elevated common	22	21
Metropolitan Elevated preferred	66	65

PERSONAL MENTION.

KARL G. FRANK, who represents the Siemens & Halske interests in this country, sailed for Europe last week to spend the summer months.

GEORGE H. HALSE, secretary of the British Columbia Telephone Company, has returned to his headquarters at Vancouver, B. C., after a six-weeks' visit in Honolulu.

N. A. KEMMISH has been chosen as general manager of the municipal electric lighting plant at Alliance, Neb. Mr. Kemmish was for a number of years connected with the Lincoln, Neb., traction company.

FRED MARSCHULD recently resigned his position with the Westinghouse Electric & Manufacturing Company of Pittsburg, Pa., and is now connected with the Great Western Power Company at Wilkinsburg, Pa.

F. W. HILD, formerly chief engineer and assistant general manager of the Havana Electric Railway Company, has been appointed general manager of the Portland Railway, Light & Power Company, of Portland, Ore.

HORACE FIELD PARSHALL, of London, England, has been appointed chairman of the Central London Railway in succession to Sir Henry Oakley. Although Mr. Parshall is as yet only a young man he has been for twenty years in the traction field, gaining much experience in this line in the United States. He has been consulting engineer to the company from the beginning of its work and is thoroughly familiar both with the engineering and administrative work. He was consulting engineer of the London United Tramways, the Bristol Tramways, the Glasgow Corporation Tramways, and is the author of many engineering works.

GEORGE A. DAMON, managing engineer of the Arnold Company, Chicago, has been made dean of engineering of the Throop Polytechnic Institute, Pasadena, Cal. He will continue his work with the Arnold Company, which has recently brought him to Southern California, but will devote considerable time to the upbuilding of the engineering course at Throop. Mr. Damon is a graduate of the University of Michigan of the class of 1895. Since the fall of that year he has been continuously associated with Bion J. Arnold in all branches of consulting engineering work, the last two or three years being particularly devoted to public utility problems.

ANDREWS ALLEN and JOHN A. GARCIA have incorporated the Allen & Garcia Company to do a consulting and contracting engineering business with offices in the McCormick Building, Chicago. Mr. Allen was associated with the engineering department of the Edge Moore Bridge Works for eight years. For the last twelve years he has been contracting engineer of the Chicago offices of the Wisconsin Bridge & Iron Company, where he has designed all kinds of bridge and structural work and specialized in the design and construction of coal mining, screening and storage plants. He is a member of several engineering societies and two years ago was president of the Western Society of Engineers. Mr. Garcia has for ten years been engaged in the survey, construction, development and operation of numerous coal mining properties in the Middle West and has examined and reported on such properties in all parts of the United States. The Allen & Garcia Company will undertake the examination, design and construction of engineering structures, bridges, coal mining, screening, handling and storage plants.

NORMAN MACBETH, for twelve years consulting engineer in the gas and electric lighting fields, and for the past two years engineer in charge of the illuminating engineering laboratories of the Welsbach Company, on May 1 assumed the position of illuminating engineer of the Westinghouse Electric & Manufacturing Company and the Westinghouse Lamp Company. Mr. Macbeth was born in Stayner, Ontario, Canada, in 1873. From 1890 to 1897 he was engaged in the practical work of installing gas and electric equipment, in the latter year giving part of his time to the manufacture of aluminum reflectors of his own design for show-window lighting with gas lamps. From 1897 to February, 1909, he acted as consulting engineer, devoting his attention to gas and electric lighting problems, giving special attention in the former part of this period to the inspection of meters and the adjustment of rate and bill complaints. Through his expert knowledge of the subject, his practical turn of mind and his absolute adherence to sound business ethics, Mr. Macbeth succeeded in establishing for himself, in this difficult field, an enviable reputation. A portion of his time during the latter part of this period was devoted to constructing as well as consulting illuminating engineering. In 1908 he engineered, in Philadelphia, the first complete installation of inverted gas lamps to be designed in strict accordance with illuminating engineering principles. His work with the Welsbach Company began in February, 1909. During the two years in this service he has created a well equipped department of illuminating engineering as applied to gas lighting. Mr. Macbeth has been a frequent contributor to the technical press and to the proceedings of the Illuminating Engineering Society. He was the first to work out the "fluxpolar diagram" for determining the mean spherical candlepower from the polar distribution curve. He is a member of both the American and British Illuminating Engineering Societies; the Franklin Institute, the National Electric Light Association, the National Commercial Gas Association, and the American Association for the Conservation of Vision. He is an associate member of the American Gas Institute and a number of state gas associations, including Pennsylvania, Michigan, Indiana and Iowa. Mr. Macbeth was one of the lecturers in the Johns Hopkins University course in illuminating engineering given under the auspices of the Illuminating Engineering Society.

NORMAN MACBETH.

OBITUARY.

RUTHERFORD DORMAN RUBRIGHT, auditor of the Edison Electric Illuminating Company of Brooklyn, died on April 20, after only a week's illness. Prior to his connection with the Brooklyn company Mr. Rubright had been employed by the Consolidated Gas Company and by the Westchester Lighting Company, of which corporation he had been auditor.

ALEXANDER E. BROWN, president of the Brown Hoisting Machinery Company and inventor of numerous ore and coal-handling devices, died at his home in Cleveland, Ohio, recently. He was stricken with paralysis a few months ago. Mr. Brown was educated in the schools of Cleveland and later took a special course in civil engineering at the Brooklyn Polytechnic Institute. He was a member of the American Society of Civil Engineers and other engineering societies.

NEW PUBLICATIONS.

PRODUCER GAS.—"Essential Factors in the Formation of Producer Gas" is the title of bulletin No. 7, just issued by the Bureau of Mines. The authors, J. K. Clement, L. H. Adams and C. N. Haskins, detail an investigation of the chemical and physical processes that take place in the gas-producer in which they kept in view not only the possibility of increasing the efficiency of the producer as a source of energy and the ensuing benefits to the public of cheaper power and greater utilization of low-grade fuels, but also the application of the results to the problems of boiler-furnace operations. The bulletin is of a scientific character and will be of interest to engineers engaged in gas-producer and gas-engine work. Copies may be obtained by addressing the Director of the Bureau of Mines, Washington, D. C.

BOSTON COMPANY'S SOUVENIR BOOKLET.—The Edison Electric Illuminating Company, of Boston, has published a very interesting souvenir of its twenty-fifth anniversary. The company was organized December 26, 1885, with a capital of $100,000, which included a payment of $35,000 to the Edison Electric Light Company, the parent company, for license rights under the Edison patents. The souvenir booklet describes in detail the organization of the company and is replete with historical data of a most interesting and instructive nature. There are also numerous illustrations. A valuable feature of the booklet is the chronological data based upon the important events in the history of the company. There is also a complete financial statement of the capital, gross earnings, expenses, earnings from operation, ratio of expenses to gross earnings, the per cent dividends paid and the cumulative cash paid in dividends from the organization to the present day.

BULLETIN OF THE BUREAU OF STANDARDS.—The first number of Vol. 7, of the *Bulletin* of the Bureau of Standards has appeared under date of February, 1911, and contains the following articles: "Note on the Temperature Scale between 100 and 500 Degrees Centigrade," by C. W. Waidner and G. K. Burgess; "A New Form of Direct-Reading Candlepower Scale and Recording Device for Precision Photometers," by George W. Middlekauff; "A Device for Measuring the Torque of Electrical Instruments," by P. G. Agnew; "The Intensities of Some Hydrogen, Argon, and Helium Lines in Relation to Current and Pressure," by P. G. Nutting and Orin Tugman; "The Temperature-Coefficient of Resistance of Copper," by J. H. Dellinger; "The Electrical Conductivity of Commercial Copper," by F. A. Wolff and J. H. Dellinger; "On the Constancy of the Sulphur Boiling Point," by C. W. Waidner and G. K. Burgess; "Notes on Oscillatory Interference Bands and some Practical Applications," by George O. Squier and Albert C. Crehore. Copies of any of these articles in the form of separate reprints may be had upon application to the Director, Washington, D. C.

PROPOSALS.

POST OFFICE, PANA, ILL.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 17, for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States post office at Pana, Ill., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Pana, or at the Supervising Architect's office.

FORT COLLINS, COLO.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 23, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States post office at Fort Collins, Colo., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Fort Collins, or at the Supervising Architect's office.

POST OFFICE, GREENWOOD, MISS.— The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 24, for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States post office at Greenwood, Miss., in accordance with the drawings and specification, copies of which may be obtained from the custodian of site at Greenwood, or at the Supervising architect's office.

POST OFFICE, CHARLESTON, W. VA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 16 for the extension, remodeling, etc. (including plumbing, gas piping, electric conduits and wiring), of the United States post office and court house at Charleston, W. Va., in accordance with drawings and specifications, copies of which may be obtained from the custodian of the building at Charleston, or at the Supervising Architect's office.

POST OFFICE, RICHFORD, VT.—The Office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 27 for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States post office and custom house at Richford, Vt., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Richford, or at the Supervising Architect's office.

FOREIGN TRADE OPPORTUNITIES.

(From Daily Consular and Trade Reports, issued by the Bureau of Manufactures, Washington, D. C. In replying to Bureau for addresses refer to file number.)

NO. 6538. ELECTRICAL SIGNS AND APPLIANCES.—An electrical engineer in France has written to an American firm that he would like to enter into correspondence with American manufacturers of electrical advertising signs and other electrical appliances with a view to securing the agency for Paris or the whole of France.

NO. 6439. ELECTRICAL LINES.—The Bureau of Manufactures is in receipt of a communication from a manufacturer's agent, stating that he has a sales organization at six points in Brazil and will represent manufacturers as sales agent on a commission basis. He is especially anxious to get in touch with firms handling electric fans and other electrical lines, automobiles, etc.

NO. 6572. SUBMARINE CABLE.—Consul General John P. Bray, of Sydney, Australia, has forwarded copies of tender forms, specifications, and conditions governing a contract for the supply of a specified quantity of submarine cable. Bids for the supply of this article will be received until June 7, 1911, at the Post Office departmental stores, Sydney, Australia. Copy of the specifications and form of tender can be obtained by addressing the Bureau of Manufactures.

INDUSTRIAL ITEMS.

DUPLEX METALS COMPANY, Chester, Pa., lists its galvanized wire, and special-grade copper wire in a recent folder.

THE NEW YORK & OHIO COMPANY, Warren, Ohio, has issued its April price list on carbon, Mazda, tantalum and Gem lamps, together with discount sheet.

C. S. OSBORNE & COMPANY, Newark, N. J., lists a complete line of standard tools, tool bags, etc., in an attractive catalog which was recently prepared.

THE MECHANICAL APPLIANCE COMPANY, Milwaukee, Wis., has appointed J. A. Adamson, 229 Manhattan Building, as its Chicago agent. The company manfuctures the Watson motors.

ROME WIRE COMPANY, Rome, N. Y., advertises its bare and tinned copper wire, magnet and annunciator wire and rubber-covered code and telephone wires on a recently mailed post-card calendar.

FRANK MOSSBERG COMPANY, Attleboro, Mass., illustrates in a recent catalog its line of metal spools, steel reels, steel beams, jack spools and flanged and flat discs. A line of advertising novelties is also listed.

THE CARLISLE-JOHNSON MACHINE COMPANY, Manchester, Conn., illustrates the Johnson friction clutch in catalog "E." A number of drawings which are included are given in connection with the dimensions and prices.

H. W. JOHNS-MANVILLE COMPANY, Cleveland, O., has distributed the April number of *The J.-M. Packing Expert*. This issue considers especially the J.-M. metallic packing designed to fit into the stuffing box used for soft packing.

THE WALPOLE RUBBER COMPANY, Walpole, Mass., announces that E. C. Green has again become associated with it in the capacity of general purchasing agent. Mr. Green's headquarters are to be at the factory office in Walpole.

KURTZ & COMPANY, 622 Monadnock Block, Chicago, have been appointed Chicago representatives for the Economy Switch Box & Manufacturing Company of Cleveland, O., makers of switches, plates, boxes for knob and tube and conduit installation.

THE SANGAMO ELECTRIC COMPANY, Springfield, Ill., has issued an instruction book showing the charging connections of the more prominent electric vehicles, which will interest those managers contemplating the installation of charging apparatus.

E. H. NAGELSTOCK annouces that he has opened an office at No. 1206 Rector Building, Chicago, Ill., where he will be pleased to attend to the wants and offer suggestions to his former patrons in the purchase and sale of all kinds of electrical apparatus.

THE C-A WOOD PRESERVER COMPANY, St. Louis, Mo., announces that the poles ordered by the Minneapolis General Electric Company from the Valentine Clark Company and the Page & Hill Company, are all to be butt-treated with C-A wood preserver.

THE NEW YORK & OHIO COMPANY, of Warren, O., is issuing two illustrated folders, one giving a revised price schedule, and the other a revised discount schedule for the "Packard" incandescent lamps. Both of these folders may be obtained free on application.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., illustrates Triumph transformers for power and lighting in a folder which was recently sent to the trade. Especial mention is made of the low core loss, low copper loss, good regulation and low reactive drop.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has prepared a booklet dealing with Westinghouse static protective apparatus. A number of types of gap and electrolytic arresters are illustrated, together with several types of choke coils.

THE REYNOLDS-DULL FLASHER COMPANY, Chicago, Ill., describes in a recent folder its numerous types of flashers for electric signs and displays. An interesting feature of this folder is the statement of the points on which the company desires information from those placing orders.

AMERICAN CONDUIT COMPANY, New York, N. Y., is mailing a number of inserts advertising bituminized fiber conduit for underground construction. One of the advertising slips shows an illustration of a truck-load consisting of 1,512 feet of fibre conduit manufactured by this company.

JAMES LEFFEL & COMPANY, Springfield, O., is mailing the 1911 edition of catalog "T," describing and illustrating its line of Leffel steam engines and boilers. A number of sectional views of the boilers and also sections and parts of the various types of engines give an excellent idea of the company's products.

THE SPRAGUE ELECTRIC COMPANY announces the removal of its Boston office from the Weld Building to 201 Devonshire Street, Boston, where larger offices have been obtained in order to handle expeditiously the increased demand for the Sprague electric apparatus and Sprague conduit products in the New England territory.

THE FANCLEVE SPECIALTY COMPANY, Boston, Mass., illustrates and describes a varied line of new material for interior electrical canstruction in a recent catalog. The new features are principally fittings for use with metal moldings, and others for use with flexible metal conduits and armored cables which employ the clamp type of connector for fastening and grounding.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., is distributing bulletin No. 1622, descriptive of the equipment of the Manhattan high-pressure fire-service system, together with the results obtained with its use. The pumping units are shown by illustrations and a diagram of the station itself gives an idea of the arrangement of the hydraulic and electric apparatus.

DAVID G. HOWEY, Kilbourn, Wis., announces that he has been appointed superintendent of the municipal water and light plant of that city and wishes to receive catalogs from electrical supply and apparatus manufacturers. In addition to managing the business of the plant, which will give twenty-four-hour service, he will do a general engineering and contracting business in Kilbourn and the surrounding territory.

THE BRISTOL COMPANY, Waterbury, Conn., is mailing preliminary bulletin No. 146-A on the Bristol long-distance recording tachometer for continuously recording the revolutions and speed of shafting, machines, engines, blast furnaces, etc. These instruments are furnished with flexible copper connecting tubes in lengths of twenty-five feet or over. The company also describes in another publication the Bristol-Durand radii-averaging instrument for circular chart records.

THE STAR EXPANSION BOLT COMPANY, New York, N. Y., has appointed Otis & Squires of 579-581 Howard Street, San Francisco, Cal., as its western sales agents. At the new western headquarters a much larger and more complete stock will be carried than before, including Sebco expansion shields, Sebco anchors and various other Sebco products. All inquiries from the western field should be referred to Messrs. Otis and Squires, who will give all specifications prompt attention.

THE HOLOPHANE COMPANY, Newark, O., is mailing an attractive pamphlet dealing with the illumination of streets. The publication takes up the difference between light and illumination and explains the requisites of good illumination and shows how proper lighting is accomplished with the Holophane unit. A double page illustration of the street lighting units on Race Street, Cincinnati, is included and especial attention is called to the absence of halation about the units, while there is a very objectionable glare perceptible from both the lighted windows and the arc light.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, Ill., is distributing match folders advertising Kellogg material. Each match is labeled with the name of an apparatus type, such as "Farm Telephones," "Magneto Switchboards," "Pole Changers," etc. On the reverse side of the folder is given the company name and the principal types of apparatus manufactured. On the end is the familiar "Kellogg" mark in red, while on the front is a well executed lithograph of the Kellogg desk stand with the company slogan, "The Service of the Telephone Proves the Worth of the Line."

THE INTERNATIONAL ELECTRIC FIXTURE & CONTRACTING COMPANY, of St. Louis, Mo., has obtained the contract for supplying all electric fixtures for the new Central Library, now in course of construction at Thirteenth and Olive Streets. The contract price is in the neighborhood of $12,000. Fifteen New York, Chicago, Boston and St. Louis firms submitted designs to Cass Gilbert, of New York City, the architect who prepared the plans for the building. Many of the library rooms will be illuminated with what is known as the Iseco indirect system of lighting, which is designed to prevent glare.

CHICAGO FUSE MANUFACTURING COMPANY, Chicago, Ill., describes in catalogue No. 25 the entire line of Union outlet and switchboxes. The catalogue is quite comprehensive and covers requirements met with in electrical installations where switch and outlet boxes are needed. Attention is directed to several new forms of outlet boxes and sealing plates, and to a universal switchbox with a corresponding line of special covers. A table is included

showing the corresponding catalogue numbers of the various other box manufacturers, and the method of packing goods for shipment to customers is especinally mentioned.

JOHN H. FOWLER & COMPANY, Chicago, the well known dealers in Idaho cedar poles, announces that it is well equipped to meet the demands of pole consumers. The company has an exceptionally choice stock of Western poles and can make prompt shipment. Users of poles will be interested to learn that this company is now installing a plant for treating the butts of poles. This plant will be located at Whiting, Ind., just south of Chicago. The Fowler Company has recently established a Chicago yard, which, together with the butt-treating plant at Whiting, will enable it to meet every demand that may be made upon it by pole users.

THE ECONOMY ELECTRIC SUPPLY COMPANY, Monadnock Block, Chicago, has secured the sole selling rights for the State of Illinois from the Straight Filament Lamp Company of New York, makers of the O'Brien incandescent lamp. This is a tube lamp of sixteen candlepower, working at a very high efficiency. It is a metalized carbon-filament lamp. It is particularly adapted for theaters, store-window displays and is especially suited to indirect lighting. Wallace F. Kirk, who was secretary of the drainage board under R. R. McCormick's administration, is president; Robert W. Means is treasurer, and David Margesson is secretary, of the Economy Company.

THE MINERALLAC ELECTRIC COMPANY, Chicago, Ill., describes in recent folders the Chicago printing attachment for integrating meters, the Minerallac cable and conduit hangers, and electroscopes for indicating the presence of dangerous potentials. This latter instrument consists of a very delicate silver leaf which is mounted upon a copper terminal which is hermetically sealed with a glass tube. The metal cap of the tube forms the test terminal which is advanced towards the conductor or apparatus. The silver leaf when brought into the proximity of a charged terminal assumes a perpendicular position. The application of this instrument is shown in an illustration contained in this folder.

THE HANSON & VAN WINKLE COMPANY, Newark, N. J., announces that its Chicago composition factory is now in operation. This company manufactures electroplaters' chemicals, polishers and buffers and dynamo electric machines for all purposes. The new factory at Chicago is equipped for the manufacture of Tripoli composition in all grades, "Rex" white buffing composition, "Brilliant Finish" lime composition and "Crocus" composition, emery cake and emery paste. The Chicago factory is to be under the direct supervision of George P. Stevens.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., recently received among other orders, one for 100 street-railway motors from the Metropolitan Street Railway Company, of Kansas City, Mo. This is a duplicate of an order for 200 motors placed by the Metropolitan with the Westinghouse Company last year. The Sioux City Service Company has recently placed orders with the Westinghouse Company for a large number of modern interpole motors of thirty-horsepower capacity to replace all old types of motors now in service.

DATES AHEAD.

American Foundrymen's Association, American Brass Founders' Association and the Associated Foundry Foremen. Annual convention, Pittsburg, Pa., May 23-26.

National Electric Light Association. Annual convention, New York City, May 29 to June 3.

Commercial Section, National Electric Light Association. Meeting and banquet, New York, N. Y., June 1.

National District Heating Association. Annual meeting, Pittsburg, Pa., June 6-8.

Association of Railway Electrical Engineers. Semi-annual convention, Washington Terminal Station, Washington, D. C., June 16 and 17.

Association of Railway Telegraph Superintendents. Annual meeting, Boston, Mass., June 19-23.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

American Institute of Chemical Engineers. Semi-annual meeting, Chicago, Ill., June 21 to 24.

Society for the Promotion of Engineering Education. Annual meeting, Pittsburg, Pa., June 26, 27 and 28.

American Institute of Electrical Engineers. Annual convention, Chicago, Ill., June 26-30.

Association of Railway Electrical Engineers. La Salle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) April 25, 1911.

990,219. SUPERVISORY SIGNALING SYSTEM. William G. Blauvelt, New York, N. Y., assignor to American Telephone & Telegraph Co. Filed Oct. 26, 1910. Comprises two supervisory lamps for signaling the central-station operator, one when a connection is wanted and the other when it is to be broken.

990,229. INDIVIDUAL-PROTECTOR UNIT AND MEANS FOR MOUNTING SAME. Frank B. Cook, Chicago, Ill. Filed Aug. 2, 1909. A protecting device for a telephone distributing frame has a forked spring for removably attaching it to a post on the mounting plate of the frame.

990,234. TERMINAL FOR ELECTRIC CABLES. Charles W. Davis, Edgeworth, Pa., assignor to Standard Underground Cable Co., Pittsburg, Pa. Filed June 19, 1909. A thimble is secured to the sheath; into this fits a glazed porcelain sleeve; a rubber stopper fits into the sleeve and around the conductor.

990,235. JUNCTION-BOX STRUCTURE FOR ELECTRICAL CONDUCTORS. Charles W. Davis, Edgeworth, Pa., assignor to Standard Underground Cable Co. Filed July 1, 1909. Has a partition parallel to the front of the box. Through the partition pass pole terminals from the separate cable-terminal compartments in the rear. The front compartment has a disconnecting switch and is partly filled with oil.

990,249. STARTING-VAPORIZER FOR EXPLOSIVE-ENGINES. Joseph F. Garcia and Harry Hertzberg, Brooklyn, and Abbot A. Low, Horseshoe, N. Y.; said Garcia and Hertzberg assignors to said Low. Filed Oct. 7, 1907. The mixing chamber contains a hollow vaporizing tube surrounded by resistance material through which an electric heating current is passed.

990,264. AUTOMATIC ELECTROMAGNETIC SPEED-CONTROLLER. Harry Hertzberg, New York, N. Y., assignor to Abbot A. Low, Horseshoe, N. Y. Filed Oct. 17, 1907. The governor of an internal-combination engine controls an electric circuit containing an electromagnet that regulates the admission of fuel to the cylinders.

990,265. ELECTRICALLY-HEATED TOOL. Harry Hertzberg, New York, Abbot A. Low, Horseshoe, and Maurice J. Wohl, New York, N. Y., assignors to Economy Electric Co., Brooklyn, N. Y. Filed Nov. 4, 1907. A soldering iron contains a number of electric heating units and means for controlling the current to each.

990,274. STORAGE BATTERY. Edgar Jonas Knapp and Edward Daniel McLaughlin, Milwaukee, Wis. Filed March 28, 1910. A battery electrode comprises a supporting member in the form of an over-lapping shell, an expansible porous container disposed inside the shell, and active material held by the container.

990,275. TELEPHONE-TRANSMITTER. Stanislaw A. Koltonski, Boston, Mass. Filed May 23, 1907. A ring frame has a two-armed bridge. The diaphragm is situated between the bridge and frame and a variable resistance is supported partly by the bridge and partly by the frame.

990,285. ELECTRIC SWITCH DEVICE. Robley D. Moyer, Tampa, Fla., assignor of one-half to Henry B. Riden, Tampa, Fla. Filed April 4, 1910. A ratchet wheel is electrically operated to interrupt a circuit.

990,317. POWER-DRIVE FOR ADDING-MACHINES. Jesse G. Vincent, Detroit, Mich., assignor to Burroughs Adding Machine Co., Detroit, Mich. Filed Aug. 13, 1906. An electric motor is connected to the machine through a clutch governed by a clutch closer.

990,342. ELECTRIC CLOCK AND LIKE INSTRUMENT. Henry Creese, London, England. Filed Dec. 10, 1909. A circular series of independently swiveled weighted arms is arranged to have each arm swung outward at the top of the wheel by an electromagnet, thus causing one side of the wheel to become heavier and to descend steadily.

990,343. ELEVATOR SAFETY DEVICE. Frank J. Crouch and Huldia E. Lloyd, Seattle, Wash. Filed Sept. 9, 1910. Opening of one of the doors leading to the shaft opens the motor circuit of the elevator.

990,351. STARTER FOR INTERNAL-COMBUSTION ENGINES. John Watson Fitzgerald, Grand Rapids, Mich., assignor to Annable-Fitzgerald Engineering & Manufacturing Co., Grand Rapids, Mich. Filed July 8, 1907. Includes an electric ignition system controlled by a timer, electrically operated starting valves for the engine, electric circuits for operating the valves also controlled by the timer, and means for manually opening the valve circuits while the engine is running and closing the same while the engine is starting.

990,353. JUNCTION OR TERMINAL BOX. Leo Gudeman, New York, N. Y. Filed June 8, 1910. Comprises an exterior sleeve provided with suitable plug openings, and a number of metallic conducting blocks superposed in the longitudinal direction of the sleeve and having passages in line with the openings in the sleeve.

990,365. TELEPHONE REPEATER-CIRCUIT. Carl August Kruck-

ow, Halle-on-the-Saale, Germany, assignor of one-half to McMeen & Miller, Chicago, Ill. Filed June 10, 1907. Consists of a symmetrical inductive link having two repeaters, each of which comprises two induction coils, a circuit containing in series a winding of each coil, a battery, and a variable resistance controlled by the inductive helix of the other half; and a second circuit containing in series a winding of each coil and an inductive helix controlling the variable resistance of the other half.

990,398. ELECTRIC CABLE. Albert E. Sink, New York, N. Y. Filed July 9, 1909. Comprises a number of insulated strands intertwined longitudinally, one being grounded, while other strands serve for transmission, and an adjustable non-inductive resistance in circuit with the grounded strand.

990,400. REFLECTING FIXTURE OR CHANDELIER. William H. Spencer, New York, N. Y., assignor to George Frink Spencer, Newark, N. J. Filed Dec. 27, 1910. A semi-indirect fixture has a hemispherical diffusing globe suspended by a ring with reflector plates on its inner surface. An incandescent lamp is hung in the center of the fixture.

990,418, 990,419 and 990,420. CURRENT-TAP. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Co., Chicago, Ill. Filed June 24, 1907, and June 28, 1909. The three patents cover modifications of a combined plug and socket shell with an inclosed side tap and protection for the wires of the branch circuit.

990,434. ELECTRICAL SYSTEM FOR THE SUPERVISION OF WATCHMEN. Albert Goldstein, New York, N. Y., assignor to International Electric Protection Co. Filed May 10, 1910. Comprises a line circuit, transmitting and translating devices, manually controlled means for preventing transmission, means automatically operating to close the circuit over certain time periods, and means for sending a signal to line operating upon a failure of the circuit-closing means.

990,461. BRUSH-HOLDER FOR DYNAMO-ELECTRIC MACHINES. James Macdonald Smith and Hermann A. Knoener, East Orange, N. J., assignors to Crocker-Wheeler Co., Ampere, N. J. Filed Aug. 22, 1908. Comprises a supporting member carrying a brush-block and an arm adapted to engage the latter directly and through the intermediary of a spring carried by the arm.

990,464. CONTROLLER FOR ELECTRIC MOTORS. Floyd T. Taylor, New York, N. Y., assignor to Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Filed July 10, 1909. Includes contact member and a contact arranged to be engaged and disengaged thereby, the member, upon disengaging the contact, being adapted to stop the motors, and the member and contact being movable automatically at relatively different speeds to vary the range of operation of the motor during successive operating periods.

990,468. TELEPHONE SYSTEM. Frans Gunnar Agrell, Stockholm, Sweden. Filed Feb. 15, 1908. Relates to the supervisory signals and cord circuits for the A and B operators on a party line telephone switchboard.

990,471. CIRCUIT-BREAKER. John D. Bradford and Benjamin R. Moore, Sacramento, Cal. Filed March 21, 1910. Describes the details of one of the parts.

990,478. COUPLING FOR CONDUCTOR-WIRES. Amos D. Duvall and Walter E. Dawson, Atlanta, Ohio. Filed Nov. 4, 1910. A long shank has a wire-receiving hook at one end and an orifice for another wire in its body.

990,483. CIRCUIT MAKING AND BREAKING MECHANISM. Benjamin P. Hayes, Topeka, Kans., assignor to American Transmitter & Manufacturing Co. Filed July 28, 1909. Has a key point, a key arm adapted for contact with it, character devices and a longitudinally pivoted beam having an arm connected with the key arm and fingers adapted for separate engagement with relative character devices, and having means for regulating the tension of each finger independently of the others.

990,484. CASE FOR TELEGRAPH-TRANSMITTERS. Benjamin P. Hayes, Topeka, Kans., assignor to American Transmitter & Manufacturing Co., Topeka, Kans. Filed March 5, 1910. A keyboard case for holding a transmitter.

990,485. TELEGRAPH-TRANSMITTER. Benjamin P. Hayes, Topeka, Kans., assignor to American Transmitter & Manufacturing Co. Filed May 17, 1910. Has an actuating keyboard like a typewriter.

990,486. RAILWAY BLOCK-SIGNAL SYSTEM. Lew Johnson, Ames, Iowa. Filed Sept. 15, 1909. Includes a pair of solenoids whose cores actuate two bell crank levers on opposite ends of a toothed signal-operating bar, so as to move the bar in either direction.

990,489. PROCESS OF ELECTRICAL WELDING. Neil Macneale, Cincinnati, Ohio, assignor to Toledo Electric Welder Co., Cincinnati, Ohio. Filed Nov. 21, 1910. Two pieces of different electrical resistance are to be welded. Current is passed through each separately and then they are pressed together and included in a single circuit.

990,492. BRUSH-HOLDER. Ralph E. Noble and Louis E. Mitchell, Chicago, Ill., assignors to Morgan-Gardner Electric Co., Chicago, Ill. Filed July 11, 1910. Consists of a casing open at one end for holding the brush. Two bars in the casing are normally held apart to press the brush outwardly.

990,506. ELECTRIC FLOOR-SCRUBBING MACHINE. William H. Strange, Chicago, Ill. Filed Sept. 8, 1906. Driven by an electric motor mounted on the machine.

990,508. PLUG-RETAINER. John J. Taylor and Leroy K. Hoss, Cherryvale, Kans. Filed Jan. 24, 1911. At the sockets for the switch plugs of the connecting cords on a telephone switchboard are movable sleeves for gripping the cords to prevent their dropping.

990,512. ELECTRIC SWITCH. Thomas E. Barnum, Milwaukee, Wis., assignor to Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Filed April 23, 1909. A solenoid has a plunger whose operation alternately opens and closes a switch.

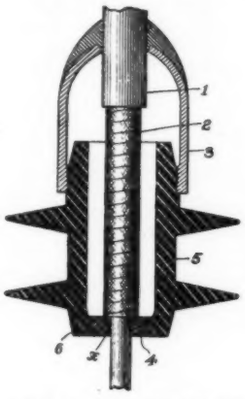
990,514. ELECTRIC LAMP. Emile Beaucoudray and Ernest Stoltz, Covington, La. Filed Oct. 3, 1910. An electric oven lamp is mounted to rotate on an insulating block provided with contacts.

990,527. TELEPHONE-MUFFLER. Fred W. Cook, Denver, Colo. Filed March 12, 1910. Has a hollow body comprising inner and outer spaced shells with a mouth-piece at one end and having a chambered portion at its opposite end to receive the instrument.

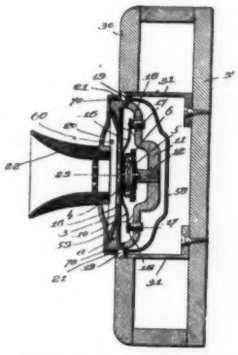
990,602. HEAT-REGULATING SYSTEM. William Douglas Smith, Chicago, Ill. Filed Jan. 29, 1908. Comprises a valve adapted when in one position to open a passage from a source of heat and when in another position to close the passage, electricity causes a motion of the valve from one to the other of the positions, an electric switch means is adapted to cause motion of the switch for part of its travel between the contact points.

990,617. ELECTRIC COOKER AND TOASTER. Russell Wiles, Chicago, Ill. Filed Jan. 21, 1911. Two heating elements are pivoted to the base and arranged to lie in one plane when lowered, the pivots being back of their adjacent edges so that when swung up they will separate to a sufficient extent to permit the insertion between them of the slice to be toasted.

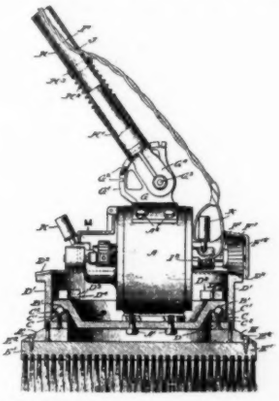
990,620. RAIL-BOND. John M. Atkinson and Lyman A. Scovil, Chicago, Ill., assignors to General Electric Co. Filed Aug. 15, 1902. Renewed Feb. 13, 1906. Comprises a lug, a flanged head, a body portion having its end resting against said head



990,234.—CABLE TERMINAL.



990,275.—TELEPHONE TRANSMITTER.



990,506.—ELECTRIC FLOOR-SCRUBBING MACHINE.

and partially surrounded by the flange, and a cap secured within the flange against the body portion, the edges of the flange being turned over the edges of the cap.

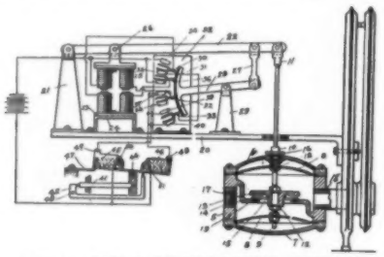
990,634. ELECTRICAL-RAIL BOND. Harry B. Conway, Boone, W. Va., assignor of one-half to Lee Long, Dante, Va. Filed Nov. 7, 1910. A bolt with a tapered head extends through a tapered hole in the bond. The bonding wire is inserted through the openings of the tapered bolt heads and drawn into tapered bushings.

990,638. TELEPHONE METER SYSTEM. Gerald Deakin, Oakland, Cal., assignor of one-half to McMeen & Miller, Chicago, Ill. Filed Sept. 10, 1908. Comprises a meter having a controlling coil serially in the telephone line; a locking-circuit for the meter and having a contact controled by it; and another contact upon the meter short-circuiting the line winding.

990,647. ALTERNATING-CURRENT MOTOR. Winder E. Goldsborough, LaFayette, Ind. Filed May 1, 1903. Has armature coils and impedance elements connected in leads from the armature coils; and an iron core having a short-circuited winding; and of means whereby the core having a short-circuited winding can be brought into closer or more distant inductive relation with the impedance elements.

990,658. INSULATING MEANS FOR PIPES AND THE LIKE. Heinrich Kumpf, Stuttgart, Germany. Filed July 26, 1905. Strips of felt are impregnated with oxychlorid of magnesium. The strips of felt are shaped or molded to the desired form and the felt fibers are held by the chemicals.

990,661. METHOD OF REGENERATING STORAGE BATTERIES. Carl Luckow, Cologne, Germany. Filed Oct. 26, 1909. Consists in first replacing the electrolyte by water and allowing the latter to become conductive by taking up the residues of the electrolyte, then passing a current through the battery in a direction opposite to the charging direction until



990,602.—HEAT-REGULATING DEVICE.

the lead peroxid of the positive electrode is turned into fungous lead and the shrunk fungous lead of the negative electrodes is loosened and changed into lead peroxid, next passing the current through the battery in a discharging direction until the zero point is crossed, thereupon turning the acidified water into a saline solution of a predetermined specific weight by the introduction of a salt, then passing the current through the battery in the charging direction until the electrodes are retransformed, and at last replacing the concentrated solution by the working electrolyte.

990,685. TELEPHONE SIGNALING SYSTEM. Egmont Max Tormin, Newton Center, Mass., assignor to Holtzer-Cabot Electric Co., Brookline, Mass. Filed March 29, 1910. The combination with a source of direct current and an electrically-operated vibrator arranged to vary the same, of a circuit connected in shunt with the winding of the vibrator, a pair of contacts in the circuit and automatic means for periodically closing and opening the circuit at a rate lower than the frequency of said vibrator.

990,709. INCANDESCENT ELECTRIC LAMP. Harry Thurston Crane, Cincinnati, O. Filed June 12, 1905. A conical reflector fits the rear tapered portion of the lamp. The screw base of the reflector fits into the lamp socket.

990,722. POWER-DRIVEN TOOL FOR DRESSING COMMUTATORS. Roe S. Freeman, Atlanta, Ga. Filed Nov. 21, 1910. A shaft is journaled in a forked yoke, a cutter being mounted on the shaft between the forks of the yoke. A supporting arm is slidably mounted on each side of the yoke, and resilient means normally maintain the arm projected beyond the end of the yoke.

990,765. ELECTRIC FURNACE. John B. Nau, New York, N. Y. Filed Oct. 31, 1910. An apparatus for refining molten pig iron. The hearth and ore shaft are so arranged as to permit oscillation.

990,767. ELECTRIC SWITCH OR CONTROLLER. Ralph E. Noble and Louis E. Mitchell, Chicago, Ill., assignors to Morgan-Gardner Electric Co., Chicago, Ill. Filed Aug. 12, 1908. Has a unitary non-yielding, rigidly mounted, current-carrying contact device or finger, a blow-out magnet for the switch, the contact device or finger also serving to carry the lines of force of said blow-out magnet.

990,790. CIRCUIT-INTERRUPTER. Egmont Max Tormin, Newton Center, Mass., assignor to Holtzer-Cabot Electric Co., Brookline, Mass. Original application filed March 29, 1910. Divided and this application filed Oct. 7, 1910. A timer for periodically controlling a signaling circuit has an electromagnet and a pivoted armature arranged when in attracted position to open the circuit through the electromagnet, spring means arranged to move the armature away from the electromagnet other springs bringing the armature within the field of the electromagnet.

990,796. DRUM-ACTUATED ALARM. Emanuel Auflero, Brooklyn, N. Y., assignor to Automobile Supply Manufacturing Co., Brooklyn, N. Y. Filed June 15, 1910. The shaft of a small electric motor is fitted with a projection which, striking against a cam attached to a diaphragm causes sound waves to be set up.

990,811. DISTRIBUTER FOR MAGNETOS. Franklin B. Hays and John M. Dinkins, Indianapolis, Ind., assignors of fifty-three one-hundredths to William L. Taylor, Indianapolis, Ind. Original application filed Nov. 4, 1909. Divided and this application filed Aug. 9, 1910. Has a plurality of insulated annularly-arranged segment-conductors and a traveling conductor adapted to sweep all of the segments at each circuit of its travel. There are also means between the driving shaft and traveling conductor for varyir g the relative travel of the shaft and conductor.

990,823. MACHINE FOR FILLING DRY BATTERIES. Philip P. Nungesser, Cleveland, O., assignor to Nungesser Electric Battery Co., Cleveland, O. Filed Nov. 25, 1910. A variable reciprocating tamping plunger has a relatively long spring to constantly sustain a portion of the weight of the plunger during its operation.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired May 1, 1911:

518,939. ELECTRIC CONDUCTOR FOR UNDERGROUND CONDUITS. Daniel E. Conner, Covington, Ky.

518,943. CONDUCTOR-PIPE FASTENER. James H. Eller, Canton, Ohio.

518,944. DYNAMO-ELECTRIC MACHINE. George Forbes, Niagara Falls, N. Y.

518,945. DYNAMO-ELECTRIC MACHINE. George Forges, Niagara Falls, N. Y.

518,946. CONSTRUCTION OF SOLENOIDS OR COILS OF WIRE USED IN ELECTRIC MACHINERY. George W. Hooper, Rochester, N. Y.

518,959. TELEPHONE. Eugenij V. Kolbassieff, Cronstadt, Russia.

518,966. STORAGE BATTERY. William A. Phillips and Justius B. Entz, Bridgeport, Conn.

518,971. ELECTRIC TIME-ALARM. Henry P. Sommer, Chicago, Ill.

519,031. ELECTROMAGNETIC VARIABLE-SPEED GEARING. Wm. W. Beaumont, London, England.

519,043. ELECTRIC HEATER. Samuel B. Jenkins, Boston, Mass.

519,045. ELECTRIC ARC LAMP. Joseph B. McKeown, Cleveland, Ohio.

519,076. SYSTEM OF ELECTRICAL DISTRIBUTION. Elihu Thomson, Lynn, Mass.

519,077. STORAGE-BATTERY SYSTEM. Jacob Trumpy, Hagen, Germany.

519,097. FIELD MAGNET FOR ELECTRIC MACHINES. Albert Schmid, Allegheny, Pa.

519,098. SELF-EXCITING CONSTANT-POTENTIAL ELECTRIC GENERATOR. Albert Schmid, Allegheny, and Benjamin G. Lamme, Pittsburg, Pa.

519,099. INCANDESCENT ELECTRIC LAMP. Frank S. Smith, Pittsburg, Pa.

519,115. ELECTRIC-RAILWAY CONDUCTOR SUPPORT. John C. Henry, Westfield, N. J.

519,116. ELECTRIC MOTOR. Frank E. Herdman, Indianapolis, Ind.

519,117. ELECTRIC ELEVATOR. Frank E. Herdman, Indianapolis, Ind.

519,120. REGULATOR FOR ELECTRIC MOTORS. Frank E. Herdman, Indianapolis, Ind.

519,121, 519,122 and 519,123. CONTROLLING DEVICE FOR ELECTRIC MOTORS. Frank E. Herdman, Indianapolis, Ind.

519,124. ELECTRIC-MOTOR-CONTROLLING APPARATUS. Frank E. Herdman, Indianapolis, Ind.

519,142. RELAY. Horace S. L. Verley, Hoboken, N. J.

519,171. MEANS FOR INTRODUCING INSULATING MATERIAL INTO CONDUITS. David Brooks, Jr., Philadelphia, Pa.

519,188. COMMUTATOR BRUSH. Rudolf Kersberg, Hohenlimburg, Germany.

519,213. AUTOMATIC ELECTRIC FIRE ALARM AND SIGNAL. Louis A. Werner and Clement J. Werner, Boston, Mass.

519,272. ELECTRIC MOTOR. Elias E. Ries and Gordon J. Scott, Baltimore, Md.

519,280. ELECTRIC GENERATOR. Wm. Baxter, Jr., Baltimore, Md.

519,281. ELECTRIC MOTOR OR GENERATOR. Wm. Baxter, Jr., Baltimore, Md.

519,283. ELECTRIC ARC LAMP. John C. Fyfe, Chicago, Ill.

519,285. BOILER. Charles S. Hopkins, Arlington, N. J.

519,291. ELECTRIC RAILWAY. William B. Purvis, Philadelphia, Pa.